Mining

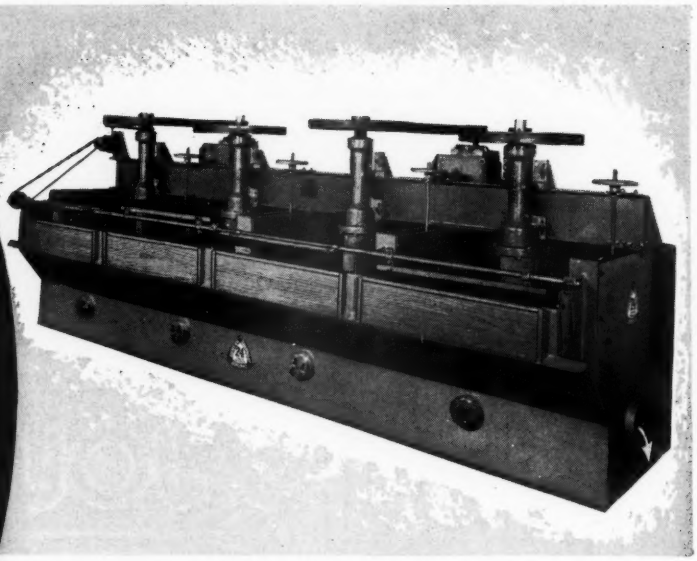
CONGRESS JOURNAL

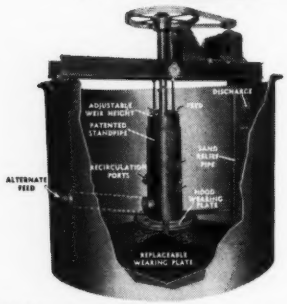
JULY
1956

DENVER CAN SUPPLY COMPLETE EQUIPMENT FOR YOUR MILL

One Responsibility

Crushers, Screens, Feeders, Ball-Rod Mills, Classifiers, Jigs, Pumps, Samplers, Agitators, Conditioners, Flotation, Thickeners, Filters, Dryers, Ore Testing and Mill Design Services.





DENVER (patented) SUPER-AGITATOR AND CONDITIONER

- Patented standpipe gives controlled recirculation.
- All feed passes through propeller zone for complete conditioning . . . no short circuiting.
- Recirculation prevents build-up of froth on surface.
- No sanding in of propeller on shutdown.
- Sizes 3′ x 3′ to 20′ x 20′.

For complete information, WRITE FOR BULLETIN NO. A2-B4.

HERE'S WHY DENVER "SUB-A" LEADS THE WORLD IN ECONOMIC METALLURGY

FLOTATION EFFICIENCY cannot be based on any single feature. Low tailings, clean concentrates, low horsepower, long part life, continuous operation, coarse feed, initial and operating costs and space required must be balanced to produce the greatest NET PROFIT FOR YOU.

Deco's "know-how" in flotation engineering is unequaled. The Denver "Sub-A" can be adapted to meet milling conditions instead of adapting your plant to meet limitations of the machine. These features of mechanical flexibility which your mill man needs to gain ECONOMIC METALLURGY are illustrated in Deco Bulletin F10-B81—sent on request.

Case histories of Denver "Sub-A" flotation in problems similar to yours will be sent on request. Flotation tests and flow sheet design services are available. Consultation is without obligation. Write today. Use our experience to help increase your **PROFITS BY FLOTATION THE MODERN WAY.**

"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEER — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

DENVER EQUIPMENT CO.

1400 Seventeenth St. • Denver 17, Colorado

DENVER • NEW YORK • CHICAGO • VANCOUVER • TORONTO

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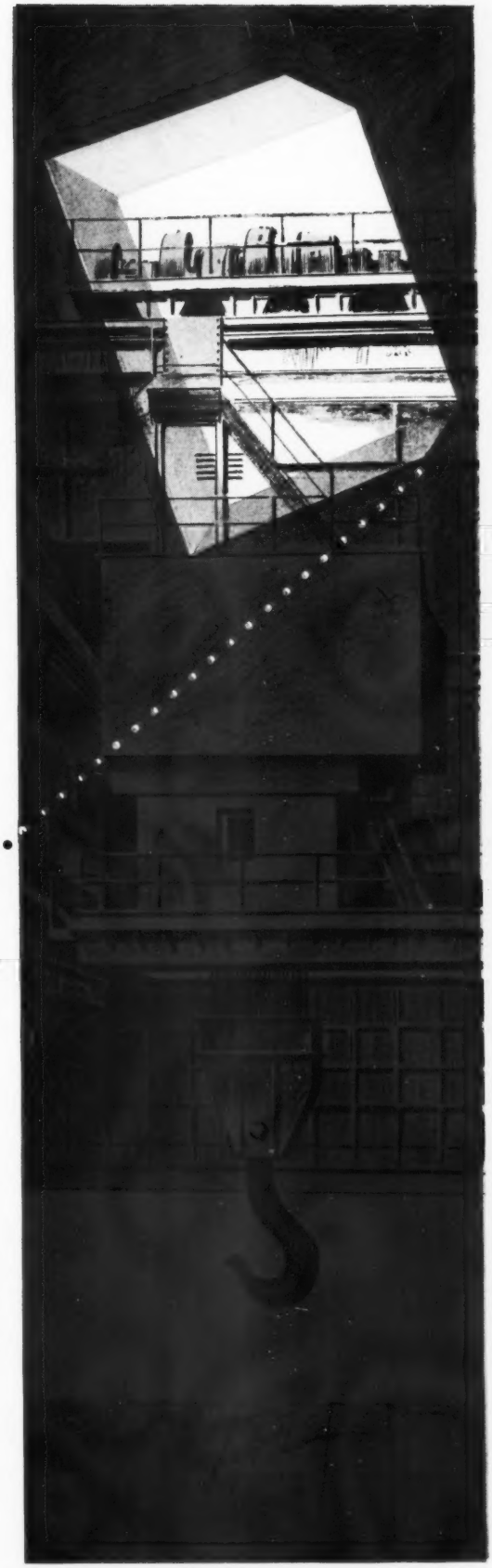
Why NATIONAL TRADE-MARK *brushes are best for*

CRANE AND HOIST MOTORS

Each Brush in the complete line of "National" brushes is compounded to meet a specific set of operating conditions. Together, these service-proved "National" brush grades provide a proper choice for every application in your mill or mine.

For Example, the following "National" brushes are recommended for crane and hoist service, as indicated. They are the finest brushes money can buy ... so much the best for these services that you will find they actually save you money in over-all cost of operation.



GRADES AX-5, TA-35, TA-45 and 401

These are standard grades with long service-records; application is in accordance with machine design.

GRADES 850 and N-4

Grade N-4 is highly efficient in handling alternate extremes of light and heavy loading; grade 850, for open-hearth ladle, soaking pit cranes and severe hoist conditions.

Be Certain of your brush selections. Get the recommendations of a "National" brush specialist to assure top performance and long life of costly equipment.

The term "National", the Three Pyramids Device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
SALES OFFICES: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco
IN CANADA: Union Carbide Canada Limited, Toronto

team up **JEFFREY SHUTTLE CARS**
and **JEFFREY BELT CONVEYORS**
for speedy, low cost coal transportation

A Jeffrey Class 66 shuttle car discharges coal directly into a Jeffrey 80-A belt conveyor at a large Kentucky mine.

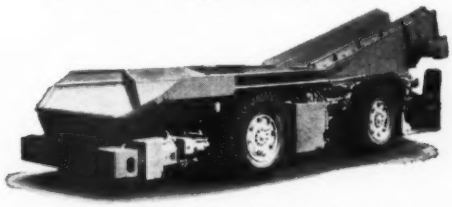
Choose from these three classes of JEFFREY SHUTTLE CARS to match your mining height

They carry big payloads and haul the coal away *fast.* 4-wheel drive, 4-wheel steering and 4-wheel braking make them safe and easy to maneuver under every mining condition. All have hydraulically driven conveyor and cable reel. Conveyor can be run slow for "jogging" when loading, slow or fast when unloading, and its direction can be reversed.

Jeffrey shuttle cars are built for continuous, rugged service.

Class 68 in heights from 24" to 32"

Class 66 in heights from 30" to 48"



Class 67 in heights from 48" to 60"
Class 90 in heights from 44" to 56"

...and BELT CONVEYORS to meet your exact requirements from the complete Jeffrey line

Three types of head sections can be combined with three types of frames, giving you nine combinations to meet any belt conveyor requirement. Jeffrey engineers will help you select the right combination for each gathering, slope or main line haulage job.

These three husky head sections can transmit from 25 to 160 HP for belt speeds from 150 to 600 FPM. Tandem drive puts the conveyor belt in maximum contact with two gear-meshed drive pulleys for most efficient use of power on a long pull.

The three frames are built for belt widths from 26" to 36", and idler roll sizes range from $2\frac{9}{16}$" to 6" dia.

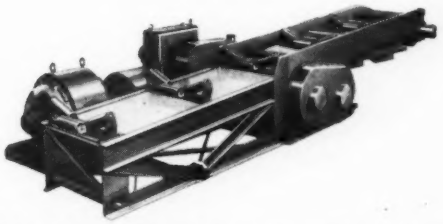
With Jeffrey shuttle cars and belt conveyors, you are assured of high-tonnage handling at low cost, less downtime and low maintenance.

The Jeffrey Manufacturing Company Columbus 16, Ohio

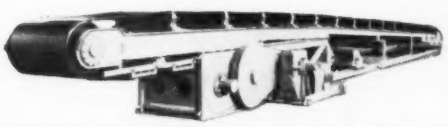
JEFFREY

MINING • CONVEYING • PROCESSING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

52-B Head Section for 25 to 75 HP motors. 52-B frames are made for 26", 30", and 36" belts, and $2\frac{9}{16}$" or 4" diameter idler rolls.



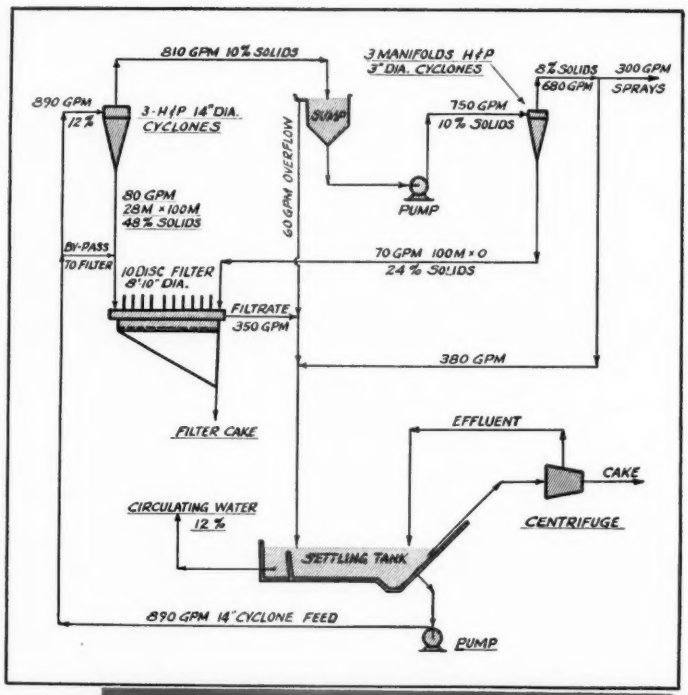
64-A Head Section for motors up to 125 HP. 64-A frames are made for 30" and 36" belts, with 4" diameter idler rolls.



80-A Head Section for motor drives up to 160 HP. The 80-A frame is adaptable to 30" and 36" belts, and 4", 5" or 6" dia. idler rolls.

0-55

Closed Circuit Operation
Recovers Good Salable Coal
from your Bleed,
Stabilizes Washing Density
and Conserves Water



X Company's Closed Circuit Does it with Heyl & Patterson CYCLONES

For the past 4 years a large West Virginia Coal Washery has been using the illustrated Closed Circuit. It is recovering 20 tph of fine coal while stabilizing the concentration of circulating water at 12%, insuring a quality-controlled product. Naturally, water problems during dry seasons are eliminated.

H & P Cyclones for Closed Circuit operation are a low-cost investment, require minimum space and combine low maintenance with ease of operation.

Utilities, Steel Companies and Coal Operators are presently using Closed Circuits individually engineered by Heyl & Patterson.

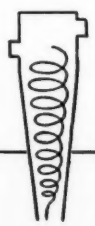
We can arrange for you to visit these plants. Find out for yourself how well the equipment operates and how quickly it can be amortized.

CHECK THESE ADVANTAGES!

- ☐ Closed circuit operation
- ☐ Recovery of fine coal
- ☐ Prevention of stream pollution
- ☐ Controlled washing water densities
- ☐ Conservation of water
- ☐ Sharp classification for washing operation

Get All The Facts... Write For Booklet CT-954

Heyl & Patterson INC.



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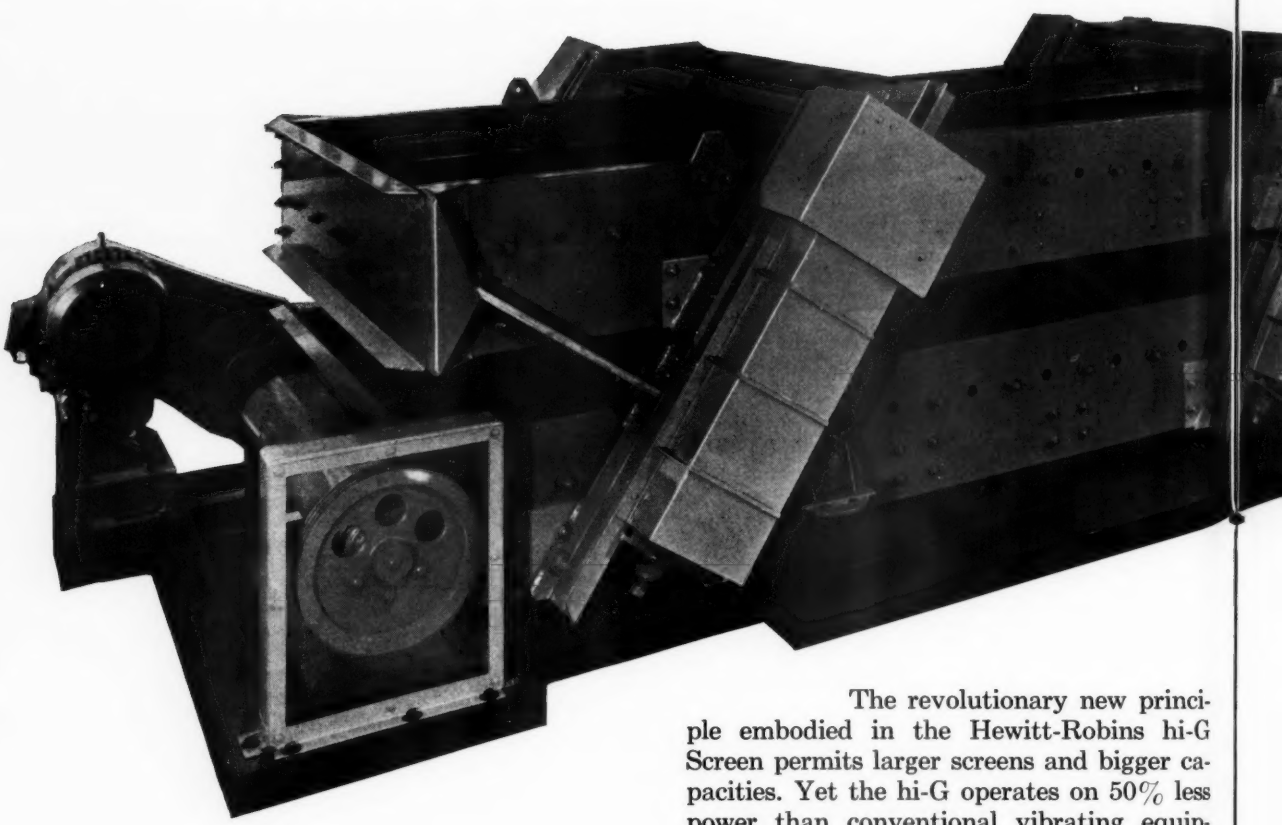
HEWITT-ROBINS *hi G* SCREENS

50 Per cent Savings



The revolutionary new principle embodied in the Hewitt-Robins hi-G Screen permits larger screens and bigger capacities. Yet the hi-G operates on 50% less power than conventional vibrating equipment! Even screens as large as 6' wide by 28' long require no more than a 20-HP drive.

Featuring an unusually sharp screening action, and a choice of stroke and speed combinations, the hi-G can be made in larger sizes than any other vibrating screen on the market.

New "Modified Resonance" Principle

Utilizing the principle of "modified reso-

INDUSTRIAL DIVISIONS PRODUCTS

VIBRATING SCREENS · VIBRATING CONVEYORS
CONVEYOR BELTING · CONVEYOR MACHINERY
INDUSTRIAL HOSE · DESIGN, MANUFACTURE, ENGINEERING AND ERECTION OF COMPLETE BULK MATERIALS HANDLING SYSTEMS
"JONES" POWER TRANSMISSION EQUIPMENT
"GLIDE RIDE" THE NEW MOVING SIDEWALK

HEWITT

STAMFORD,

SAVE POWER *Possible*

nance," the new Hewitt-Robins hi-G Screen develops a controlled, extremely sharp vibrating action. This resonance is induced by a relatively small mechanical exciter producing powerful vibrations with added "kick" to separate materials according to size.

If you need larger screens—screens that operate on or near the horizontal and still screen at large openings—*screens with readily accessible lower decks for easy observation, spraypipe installation and quick cloth changes* . . . the hi-G Screen is your answer. For information about hi-G Screens and other Hewitt-Robins vibrating equipment, contact our nearest sales office or write to our offices in Stamford, Connecticut.

HEWITT-ROBINS VIBRATING EQUIPMENT FOR THE COAL MINING INDUSTRY

GYREX SCREENS. General-purpose, positive-stroke, 4-bearing screen with amazing versatility of application and an unsurpassed record for stamina in service.

STYLES M AND MS VIBREX SCREENS. Full-floating, unbalanced, pulley-type, 2-bearing screen. Offers sharp sizing of a wide variety of materials at low cost.

STYLE J VIBREX SCREENS. General-purpose screen applicable to a wide variety of screening operations. Wide range of sizes for suspended mounting.

STYLE HS HIGH-SPEED VIBREX. For fine screening applications (up to 100-mesh in some cases). Highly effective circle-throw screening action.

ELIPTEX SCREENS. Exclusive 3-way elliptical motion for sharpest sizing and most effective dewatering. Horizontal-operating flat screens.

CAR SHAKEOUTS. Both Heavy-Duty and General-Service units for unloading all sorts of materials from hopper cars faster, more efficiently and more economically.

VIBRATING FEEDERS. Fully mechanical vibrating feeder. Easy to install, operate and maintain. Extremely high capacities at very low power consumption.

SCREEN CLOTH. Wire cloth in a variety of sizes, weaves and materials for virtually every sizing, separating or screening operation.

FOR SERVICE AND INFORMATION ON BELTING AND HOSE CALL YOUR LOCAL HEWITT-ROBINS INDUSTRIAL SUPPLY DISTRIBUTOR LISTED IN THE "YELLOW PAGES"

-ROBINS

CONNECTICUT

Now–Du Pont Offers Two New Blasting Agents for Overburden Shooting

Seven reasons why new Du Pont "Nitramite" and Du Pont Akremite* will meet your blasting needs

	DU PONT "NITRAMITE"	DU PONT AKREMITE*
√ **AVAILABILITY** *Large diameters only*	Manufactured and sold throughout the country in a wide variety of sizes.	Can be manufactured and used under sublicensing arrangement from licensed manufacturers or purchased for use from said manufacturers.*
√ **ECONOMY**	Popular combination of high strength and low cost.	Lowest-cost blasting agent developed to date.
√ **VERSATILITY**	Excellent blasting action in both hard and soft materials and either vertical or horizontal holes.	Proven performance in bituminous-coal strip pits. Potential application in wide variety of bank shooting.
√ **WATER RESISTANCE**	Good water resistance—can be loaded in water if shot within eight hours.	Recommended for loading in substantially dry holes. Package is moisture-resistant.
√ **SAFETY**	Cannot be accidentally detonated by shock, friction, rifle bullets, "Primacord," or a blasting cap. Should be primed with a special insensitive "Nitramite" Primer, which must be initiated with "Primacord."	Cannot be accidentally detonated by shock, friction, rifle bullets, "Primacord," or a blasting cap. May be primed with dynamite in standard wrappers or flexible plastic bags, or for maximum safety, "Nitramite" Primers.
√ **CONVENIENCE**	Furnished in a substantial container that is easy to handle and load—even in usually troublesome horizontal holes.	Packaged in a flexible plastic bag that loads easily and conforms to shape of borehole.
√ **NO HEADACHES**	Contains no Nitroglycerin and cannot produce "powder" headaches.	Contains no Nitroglycerin and cannot produce "powder" headaches.

E. I. du Pont de Nemours & Co. (Inc.),
Wilmington 98, Delaware

**Licensed exclusively to the Du Pont Company under the Maumee Collieries Company Process Patent No. 2,703,528.*

DU PONT BLASTING AGENTS

Blasting Supplies and Accessories

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

C·M·I

CONTINUOUS CENTRIFUGAL

Model EB-36

Economy and efficiency are combined to make C·M·I Centrifugal Dryers leaders in their field. The unprecedented basket design of this dryer provides greater capacity together with economy of operation. The coal is dried to a 6% surface moisture content without the use of expensive heat-drying operations. Increased resistance to shock loads is provided by the new V-belt direct drive, while clogging, and resulting clean-out jobs, are nearly eliminated by an enlarged and improved discharge channel.

The new C·M·I dryer provides savings in daily operation expense in addition to low installation costs. For only a few cents a ton, this dryer will actually earn extra profits for you through the reclamation of marketable coal from slurry ponds. C·M·I welcomes the opportunity to assist you with your particular problems in this field.

Model EB-36 is compact, requires little space, little headroom.

The heart of Model EB-36 is the revolving basket and inner cone.

Metal clamping rings make it possible to replace worn out screens merely by loosening a few bolts — an exclusive feature.

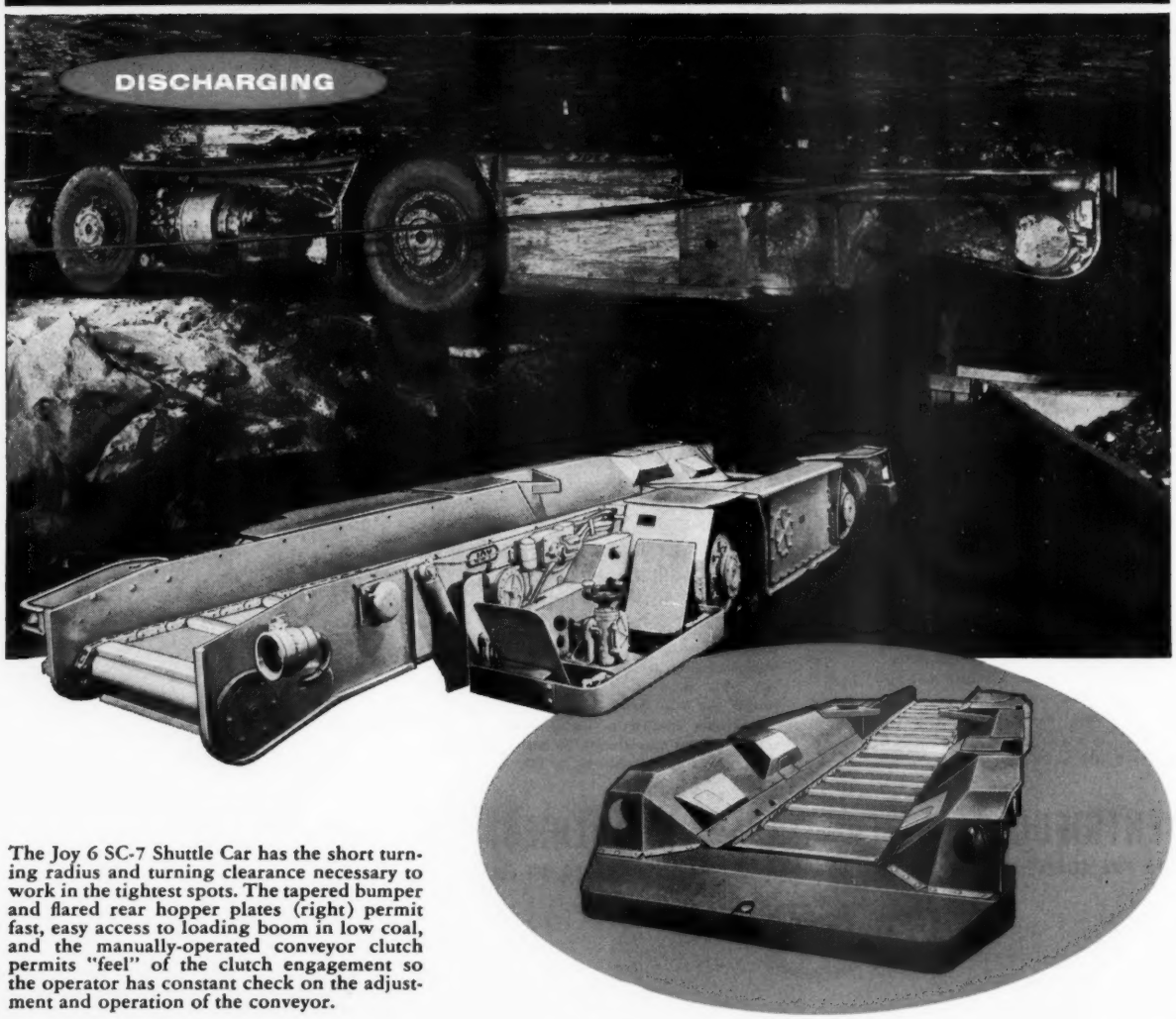
Production capacity assures prompt delivery of new equipment and replacement parts at all times.

CENTRIFUGAL & MECHANICAL INDUSTRIES, INC.

146 PRESIDENT STREET — **SAINT LOUIS 18, MISSOURI**

C·M·I Centrifugal DRYERS

LOOK HOW WE'VE IMPROVED THE



The Joy 6 SC-7 Shuttle Car has the short turning radius and turning clearance necessary to work in the tightest spots. The tapered bumper and flared rear hopper plates (right) permit fast, easy access to loading boom in low coal, and the manually-operated conveyor clutch permits "feel" of the clutch engagement so the operator has constant check on the adjustment and operation of the conveyor.

6-SC SHUTTLE CAR!

★HEAVIER WHEEL UNITS! ★EASIER STEERING! ★POSITIVE DRIVE (NO DIFFERENTIALS)! ★MORE RUGGED FRAME—BETTER IN EVERY WAY!

***HUSKY*—TO STAY ON THE JOB**

Here's Joy's latest answer to heavy-duty, efficient haulage in low seams: the great new 6 SC-7 Shuttle Car! Wheel units are stronger, and the beefed-up frame of the 6 SC-7 has a half-inch thick plate reinforcement at the conveyor hinge section, a boxed-in tapered rear, and a heavier bumper for maximum strength. New induction-hardened worm and worm gear—the latter a steel hub welded to a bronze rim—are 50% stronger than former all-bronze gears.

***EASY-TO-STEER* MANEUVERABILITY**

Four-wheel hydraulically-powered steering makes the 6 SC-7 ideal for sharp turns in close-timbered, narrow headings . . . permits exact positioning of the car under the loader for maximum output and minimum spillage. A new twin-lever type of cam-and-lever steering gear, plus simplified linkage, provide faster-acting power steering and easier handling under all conditions.

***POSITIVE* POWER**

Four-wheel positive traction drive—*with no mechanical differentials*—provides the balanced "no-spin" tractive effort you especially need on soft or irregular bottoms. Two 7½ HP heavy-duty traction motors and one 7½ HP heavy-duty pump conveyor motor assure reserve power for most requirements. Special 10 HP motors are also available where extra power and faster speeds are desired.

***FAST* TRAMMING**

The 6 SC-7 trams a 2½-ton load (3¼ tons with 4″ sideboards) at 3.7 mph, discharges in less than 35 seconds and trams back empty at 4.2 mph. With special 10 HP motors the car trams at 3.9 mph loaded, 4.7 mph empty, and discharges in 29 seconds . . . can make a complete trip from face to discharge point and back again in just a couple minutes.

***LOW . . . EFFICIENT* TO OPERATE**

This new, improved 6 SC-7 is only 29″ high without 4″ sideboards (other models available in heights up to 38½″ without sideboards). Wide operator's platform assures comfort and protection. Low rear, only 15¾″, assists loading under low roof, and the discharge conveyor is designed to permit maximum raising. The operator always uses right foot on the brake and left foot on traction.

EASILY MAINTAINED

Drive units, shafts, disc brakes, controls, etc. of the 6 SC-7 are all readily accessible. Wheel drive unit assemblies can be used in any position on the car, reducing stock problems and speeding change-overs. The simplified steering linkage has only half as many parts as formerly. Control switches above operator's platform are out of reach of dirt and water damage, and the front end cable reel mounting and large sheave-wheel guide protect the cable for maximum life.

That's only a part of the benefits built into the great 6 SC-7 Shuttle Car. Let us give you a full rundown on it . . . or any other unit in the complete Joy line of underground mining equipment, built and *field-proved* to give you the world's best job of cutting costs and increasing tonnage. ● *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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Consult a Joy Engineer

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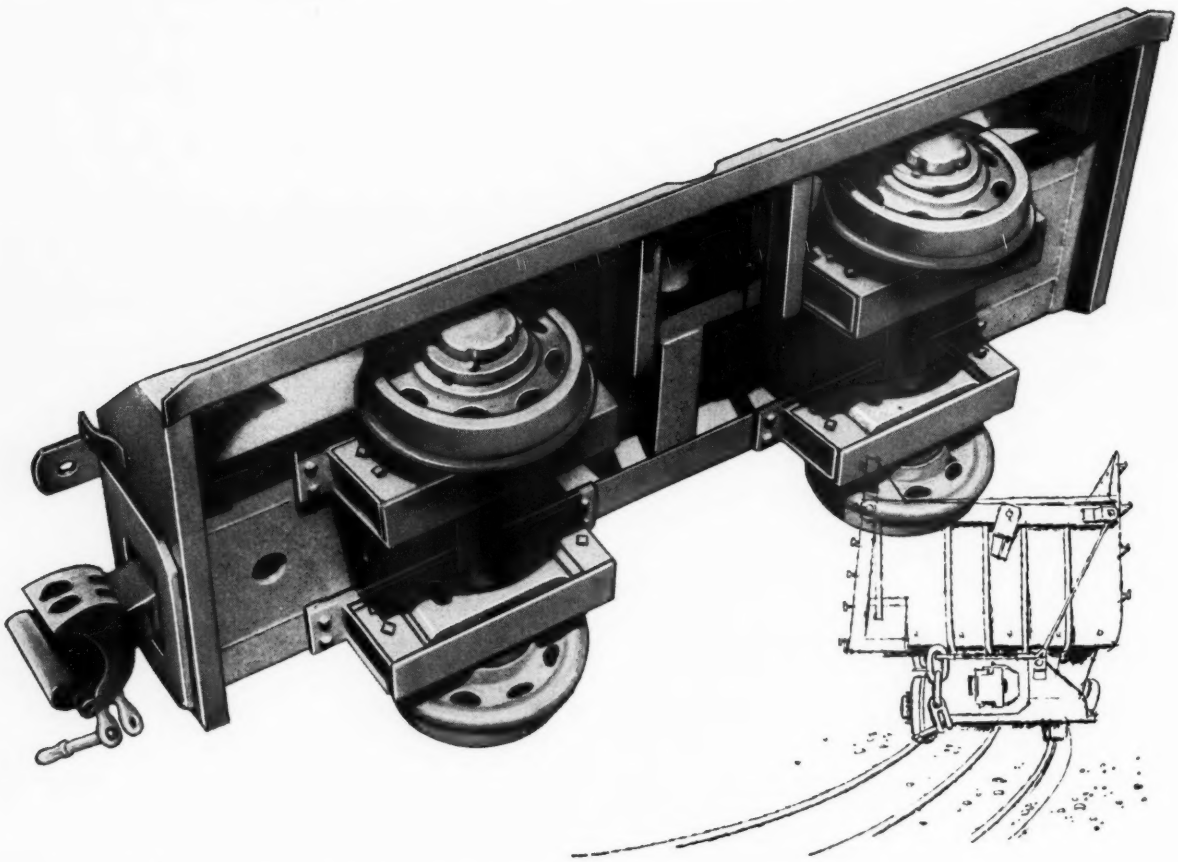
JOY

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT



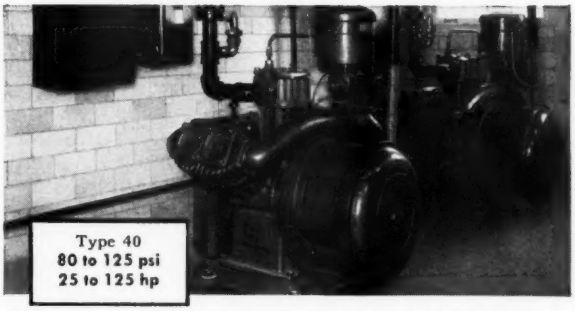
for extra strength
it's CRUCIBLE **MAX-EL** alloy steel

Mine car axles *always* take a beating. But where service is *especially* rugged, manufacturers – like C. S. Card Iron Works, Denver, Colorado – use Crucible Max-el 3½ alloy steel.
In their own words, here's why . . .
"We use Max-el 3½ because of its high-strength . . . good fatigue resistance . . . and over-all economy."
Good reasons why Max-el, or another of Crucible's wide range of special alloy steels, may be the right answer to many of your more exacting applications. Your local Crucible representative will be glad to give you more details.
Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE first name in special purpose steels

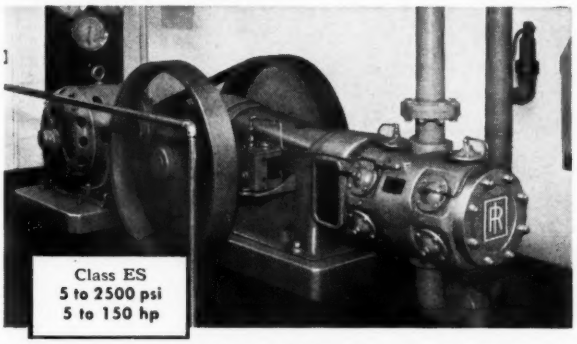
Crucible Steel Company of America

You can always depend on I-R compressors for real economy



Type 40
80 to 125 psi
25 to 125 hp

High-capacity, two-stage compressors with air-cooled cylinders and intercoolers, available with three types of electric motor drive: V-belt, flexible coupling and unit type with compressor and motor on common shaft. All units are highly efficient, compact and light in weight.



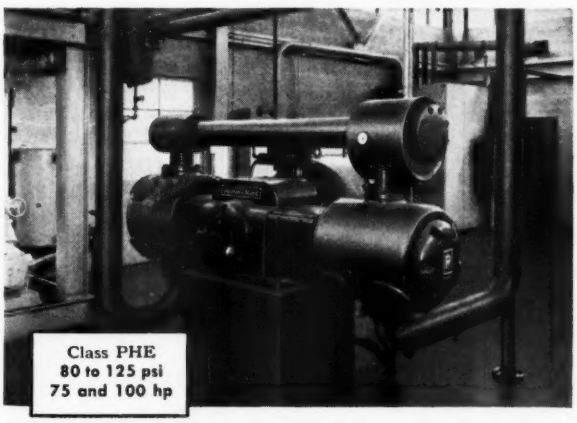
Class ES
5 to 2500 psi
5 to 150 hp

Heavy-duty units with one, two and three stages—arranged for electric motor or steam drive. These double-acting, horizontal, crosshead-type compressors, with Channel Valves and water-cooled cylinders, are built for continuous full-load service under severe operating conditions.

- *Efficient operation*
- *Low maintenance costs*
- *Easy installation*

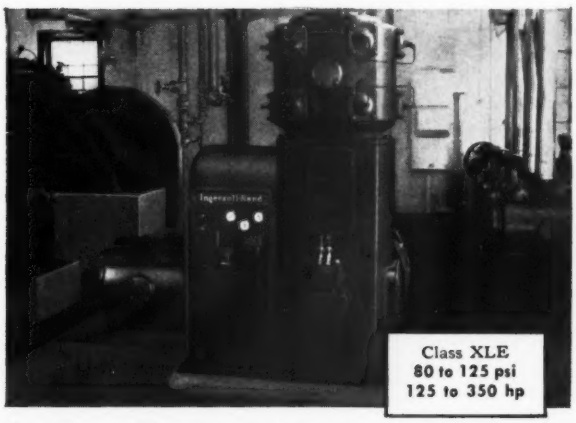
Whatever your compressed air requirements, there's an Ingersoll-Rand compressor that's *right* for the job. Because mechanical and compression efficiencies are high, the unit will deliver full rated output with consistently low power requirements. With its rugged, dependable construction, the I-R compressor will stay on the job longer, with less time out for maintenance.

You can be sure of receiving real economy from *any* Ingersoll-Rand compressor . . . a machine that is economical to install, run and maintain. Contact your nearest I-R branch for complete information.



Class PHE
80 to 125 psi
75 and 100 hp

Opposed-cylinder, balanced-design, two-stage compressors with water-cooled cylinders and built-in motor. There are no adjustments within the sealed frame. Full-floating aluminum bearings have extremely long life. Channel Valves are highly efficient. A completely packaged unit.



Class XLE
80 to 125 psi
125 to 350 hp

Heavy-duty, double-acting, two-stage, water-cooled compressors, featuring a completely new "L" design which makes the XLE simple, compact, accessible and economical. Pipeless, Thru-Frame Air Flow, Packaged intercooler and built-in electric motor save space—reduce installation, power and maintenance costs.

Only I-R compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve assembly is a combination of rigid stainless-steel channels and springs, with trapped-air spaces which cushion action.

OTHER TYPES AND SIZES . . . TO 6000 HP

Ingersoll-Rand

1-389 11 BROADWAY, NEW YORK 4, N. Y.

Use the same drill steel —just switch the TIMKEN® bits

TIMKEN® interchangeable rock bits let you switch bit types without switching drill steels

TIMKEN® interchangeable bits do away with the old-style, time-wasting chore of changing drill steels every time bit types are switched. Now drillers use the same drill steel, easily and quickly switch Timken bits as the ground changes—right on the job. Dozens of Timken bits, both multi-use and carbide insert, fit the same drill steel. It takes only a minute or less to unscrew one Timken bit and screw on a different one. Work keeps moving by using the most effective and economical bit for the ground conditions.

And savings mount. You can cut costly drill steel inventory. You get long, economical bit wear because Timken bits are made from electric furnace Timken fine alloy steel. We're the only American rock bit manufacturer that takes this extra quality control step. And Timken bits have a shoulder-union especially developed by the Timken Company that keeps drilling impact from damaging threads.

Our rock bit engineers will gladly help on your drilling problems. They'll put their more than twenty years of experience to work to help you cut your drilling costs. Just write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHERE YOU CUT COST WITH TIMKEN MULTI-USE BITS

Most economical for ordinary ground. With correct and controlled reconditioning, they give the lowest cost per foot of hole when full increments of steel can be used.

WHERE YOU CUT COST WITH TIMKEN CARBIDE INSERT BITS

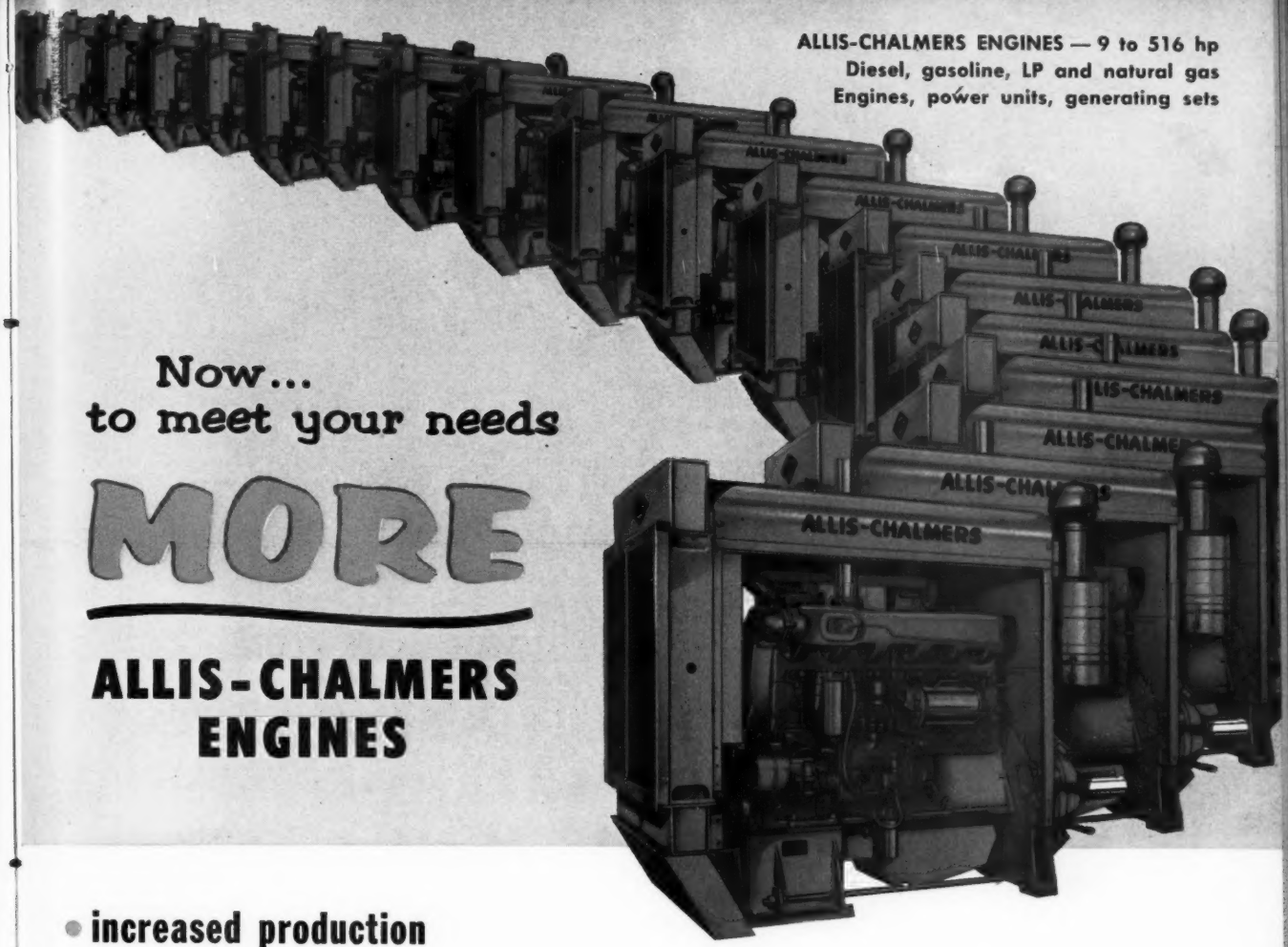
Give highest speed through hard, abrasive ground. Also most economical for constant gauge holes, small diameter holes, very deep holes.

your best bet for the best bit...for every job

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

ALLIS-CHALMERS ENGINES — 9 to 516 hp
Diesel, gasoline, LP and natural gas
Engines, power units, generating sets



Now... to meet your needs

MORE

ALLIS-CHALMERS ENGINES

- **increased production**
- **improved standards**
- **expanded service**
- **greater parts availability**
- **more parts interchangeability**

The production of Allis-Chalmers engines goes up, up, up to meet your needs. The 1956 production is expected to reach an all-time high — and 1955 output was many percent greater than 1954's. A multi-million-dollar expansion of facilities will further boost production.

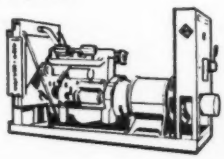
But there are not only *more* engines to meet your needs, there are *better* engines — as Allis-Chalmers research and development continues to pioneer improvements, and as production and inspection standards are set even higher.

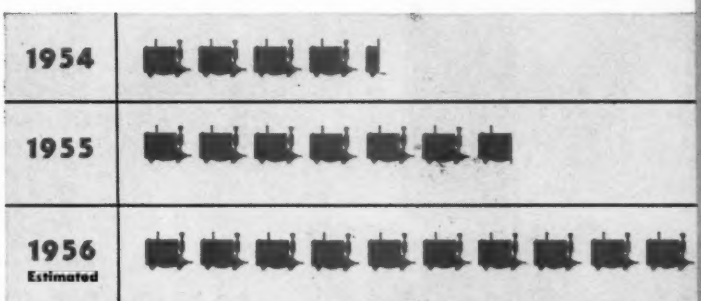
Along with this comes an expansion of customer service and greater parts availability, too, as sources of parts and service are moved closer to you.

More and more, it's Allis-Chalmers engines and service to meet your needs.

ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

A complete line of improved engine generator sets from 5 to 300 kw, for emergency and continuous duty, for marine, cooling tower and industrial use.





The 1956 production of Allis-Chalmers engines will reach an all-time high, with output many percent higher than in previous years.

ALLIS-CHALMERS

BE-3

HEADED BOLT USED WITH EXPANSION SHELL PROMOTES MINE SAFETY

Your mine becomes safer, protected from the danger of severe roof falls, when you adopt a roof-bolting program, using Bethlehem's square-head roof bolt with Type C expansion shell.

The Bethlehem square-head roof-bolt assembly promotes safety in the mine by anchoring overlying rock so that it becomes a single-unit thick beam. Installations of this type also facilitate mining and increase production, as mechanized equipment can be operated right up to the face. There's less need for storage space, too, both in the mine and topside. Besides, ventilation is improved, due to the lack of bulky supports.

The Bethlehem square-head roof bolt comes in three types: a ¾-in. carbon-steel bolt, and a ⅝-in. high-strength bolt, each with a typical breaking load of 24,000 lb, and a ⅞-in. high-strength bolt, with a typical breaking load of 45,000 lb.

Which type of roof bolt is the most suitable naturally depends on the rock conditions in the individual mine. If you would like to talk about roof bolting and the best type to use in your own mine, a Bethlehem representative will be glad to call at your convenience.

Slotted Bolt Ideal for Special Locations

Bethlehem also makes a 1-in. slotted roof bolt. The slotted bolt is used with a wedge, which is started in the 6-in.-long forged slot before the bolt is placed in the hole. Then the bolt is driven to refusal, forcing the wedge deep into the slot, spreading the bolt-ends and anchoring the bolt securely.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor: Bethlehem Steel Export Corporation

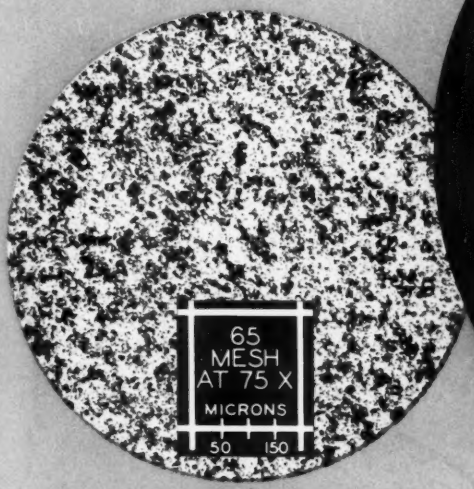
BETHLEHEM STEEL

BETHLEHEM STEEL

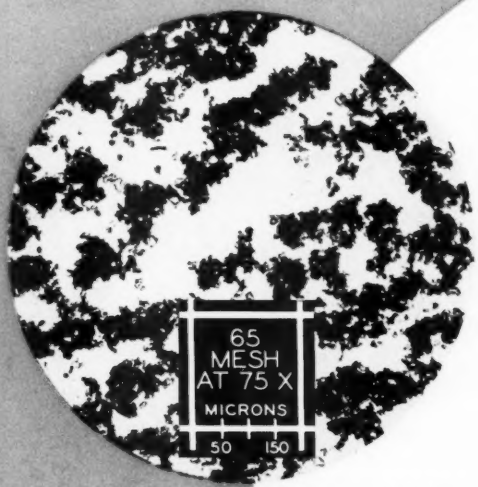
Now-a choice of

3 AEROFLOC Reagents

to flocculate wash-water fines
to accelerate settling and
assure a clear plant effluent



UNFLOCCULATED SLIMES



AFTER ADDING AEROFLOC REAGENTS

Study the photomicrographs above. Note how the addition of only 0.01 to 0.1 lb. per ton (0.1 to 5 ppm in dilute suspensions) of AEROFLOC Reagent flocculated the finely divided solids. Visualize how such powerful flocculation can improve settling of your wash-water fines and thereby minimize your stream-pollution problems.

Plant tests of AEROFLOC Reagents have shown amazingly good results. In one typical instance washery effluents containing 0.15% solids, too high for safe discharge into a stream, were treated with 0.013 lb. AEROFLOC 548 per 1,000 gallons of effluent. The solids content of the overflow was reduced to 0.005%, clear enough for discharge into the stream.

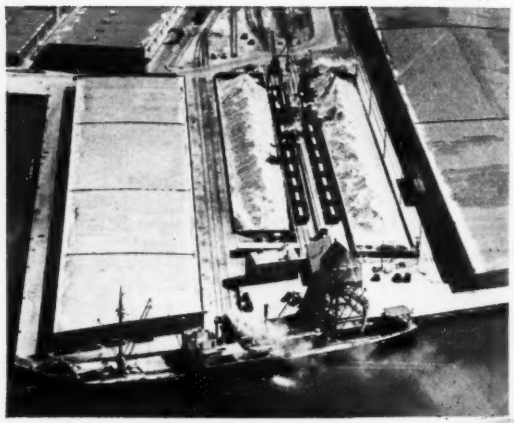
Three AEROFLOC Reagents are available—#548, #552 and #3000 each with special characteristics. We suggest that you test all three because it is not possible to predict accurately which will perform best in any given application. Samples and technical data will be sent on request.

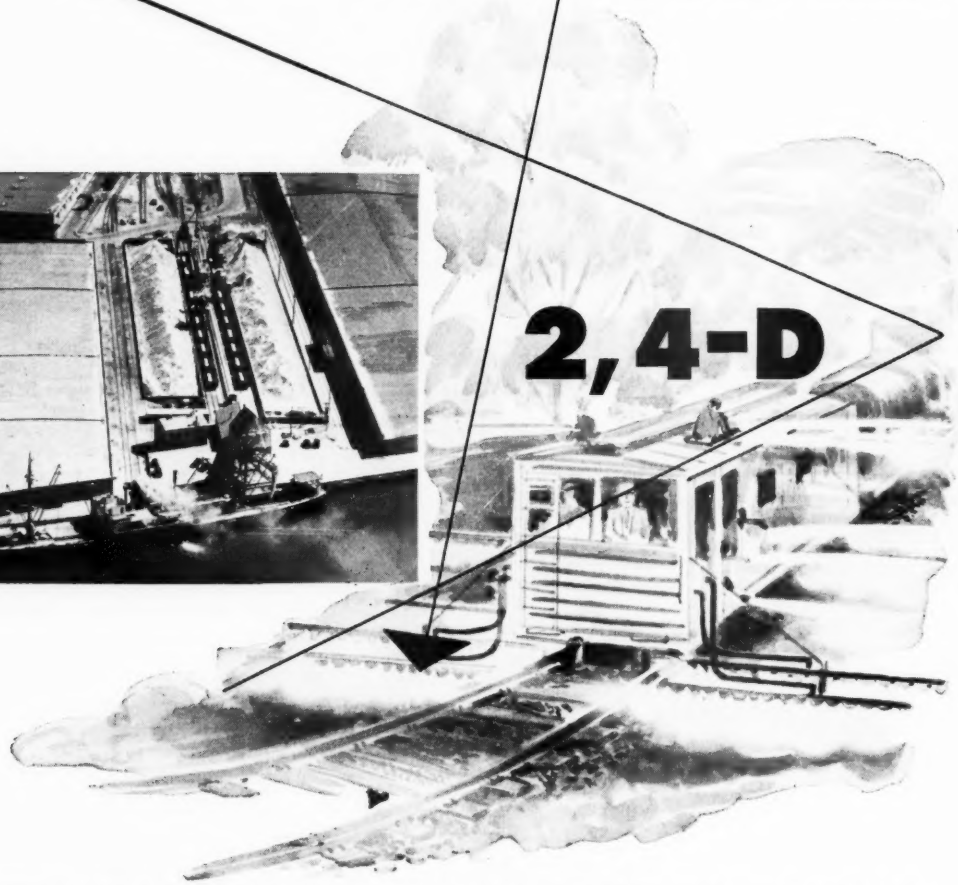
AMERICAN CYANAMID COMPANY
MINERAL DRESSING DEPARTMENT
30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK

CYANAMID

sulphur

helps to create headline products





Naturalists have said that the forests would take over our cities in short order should all human activity cease. Railroads see vivid evidence of this on a small scale. They're constantly battling weeds on rights-of-way, on sidings, on spur lines.

Today, the battle is being fought more successfully than ever before with a new and powerful broadleaf weed killer 2, 4-D. And this chemical is proving useful, too, in suburban areas.

Where does Sulphur fit into the picture? It takes Sulphur to make sulphuric acid. It takes sulphuric acid to make phenol. It takes phenol to make 2, 4-D.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N.Y.

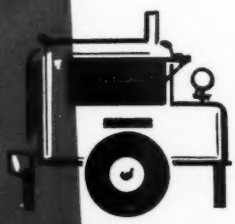
Sulphur Producing Units

- Newgulf, Texas
- Spindletop, Texas
- Moss Bluff, Texas
- Worland, Wyoming

Got a tough job?

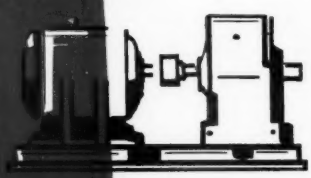
Give it to STANOIL Industrial Oil

This oil gives superior lubrication to a long list of mine equipment—here are three big jobs it can do—



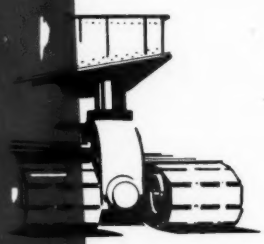
COMPRESSOR

High oxidation stability and low carbon-forming characteristics of STANOIL virtually eliminate the danger of carbon deposits on valves. STANOIL separates readily from water. There is no problem of emulsion in compressor crankcase.



SPEED REDUCER

There are many years between maintenance jobs on speed reducers when STANOIL is the lubricant. Herringbone gears remain clean and free of wear. Low pour point of STANOIL gives oil ability to flow freely from a cold start. No trouble either in prolonged, high temperature operation.



HYDRAULIC JACKS

Tough mine hydraulic service is the ideal place for STANOIL. High viscosity index and low pour point of STANOIL assure smooth operation no matter what the temperature. STANOIL resists contamination, will not emulsify.

Pick your tough lubrication jobs, give them to STANOIL Industrial Oil and get the results you have wanted. Find out more. Call your Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. He is experienced in mine lubrication. Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

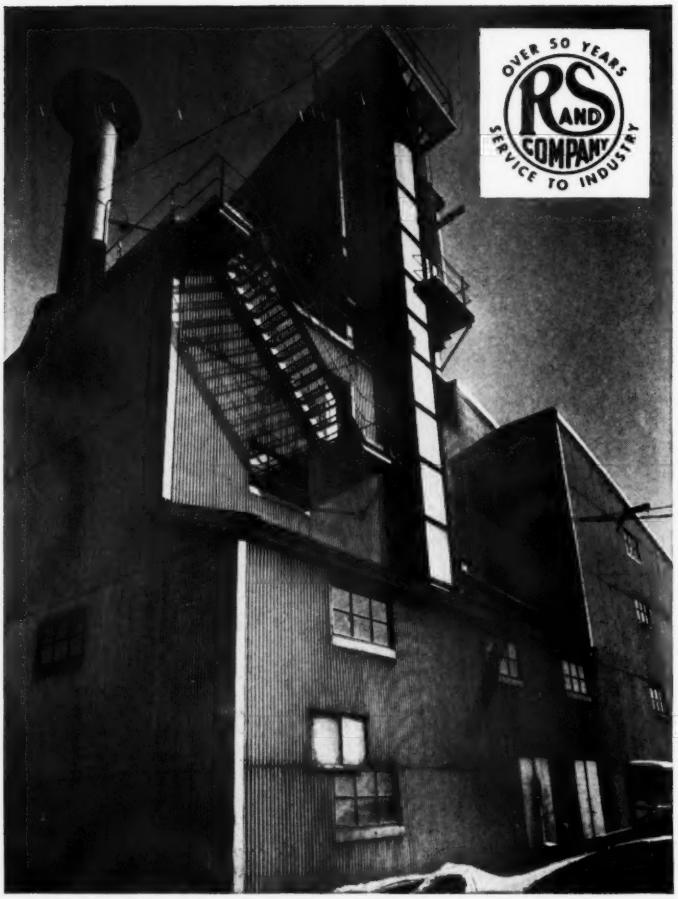
Quick Facts About

STANOIL Industrial Oil

- **Stability**—STANOIL's antioxidant gives oil resistance to chemical change, minimizes deposits.
- **Rust Prevention**—Inhibitor in STANOIL "plates out" on metal surfaces, prevents corrosion.
- **Cold Starts**—STANOIL has low pour point. Flows freely from cold start. No need for costly warm-ups.
- **Resists Effects of Temperature Change**—STANOIL has high viscosity index, is resistant to temperature change.
- **Has Excellent Demulsibility**—STANOIL is refined to eliminate emulsion problems, contains additive to minimize foaming.

STANDARD OIL COMPANY
(Indiana)

STANDARD



HAVE YOUR COAL TEST-CLEANED in the modern R&S Pilot Plant

THIS modern R&S pilot preparation plant lets you take the guess-work out of coal cleaning. Using a full carload sample, with full size equipment, under actual operating conditions, it shows exactly what R&S equipment can do for your coal. At the end of the process all end products are analyzed by an outside, unbiased laboratory—Commercial Testing and Engineering Co. You get their full report in writing, plus the recommendations of R&S coal preparation specialists.

Write for your free copy of the new Pilot Plant Bulletin that tells the full story.

ROBERTS and SCHAEFER COMPANY

Subsidiary of Thompson-Starrett Company, Inc.

ENGINEERS AND CONTRACTORS

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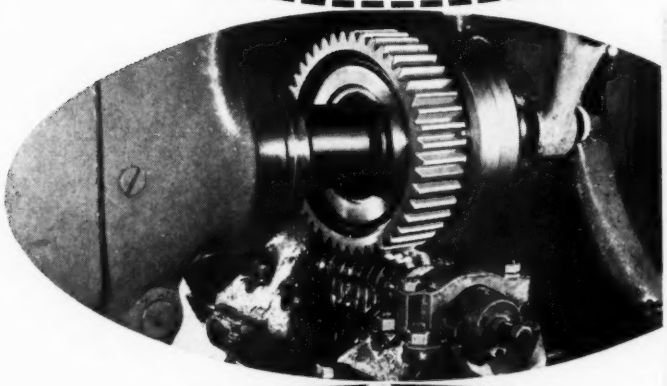
Hibbing, Minn.—P. O. Box 675

Important reasons why it pays to use True Original Parts

Allis-Chalmers True Original Parts start right. Each benefits from one of industry's most intensive metallurgical research programs. And each is designed by experienced construction machinery engineers to do a specific job . . . with ample capacity to carry a full share of the work load just as the new equipment part did.

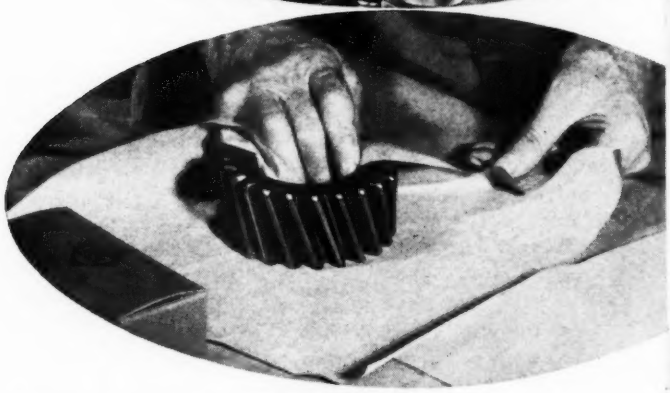


1 PRECISION-MADE

Skilled craftsmen bring True Original Parts to life—working with the most modern manufacturing equipment and meeting the highest industrial standards. The result: precision-made parts get full work power from your Allis-Chalmers machinery.

2 CAREFULLY INSPECTED

True Original Parts go through rigid original-equipment inspection and testing processes to assure long-life service. For example, gears are checked again and again for perfect meshing . . . for true balance . . . for full capacity.



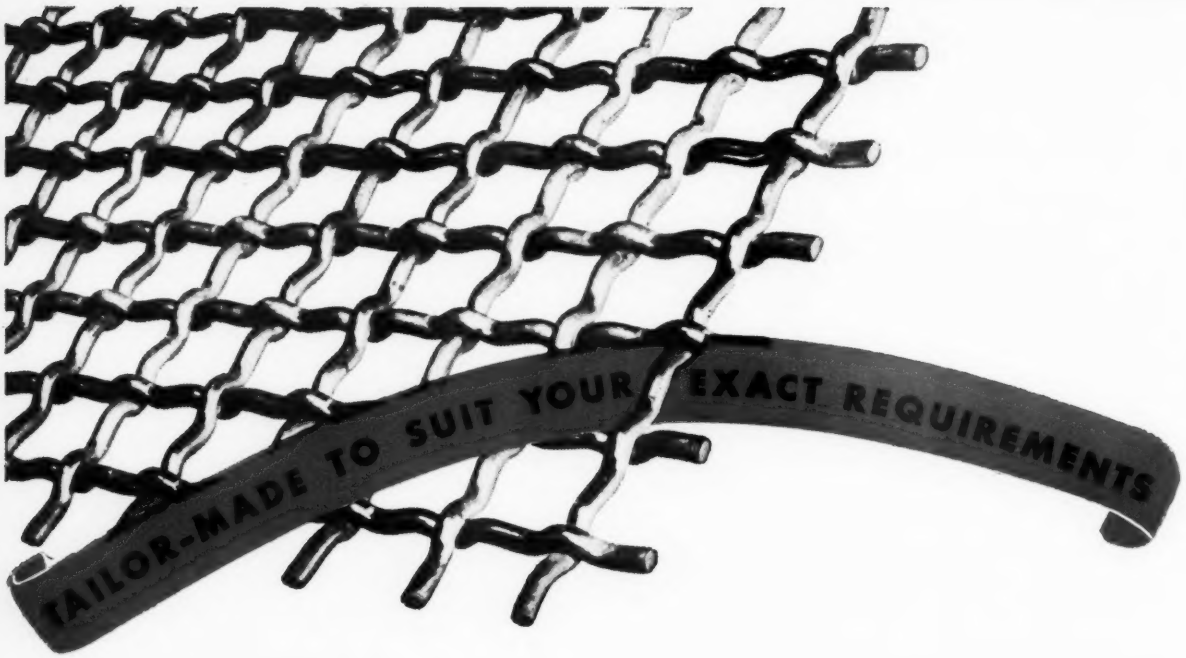
3 PROPERLY PACKAGED

You want your parts factory-new . . . and that's how you get True Original Parts. Many are specially treated . . . then sealed and packaged against rust, dust and damage.

A country-wide network of dealers stock ample supplies of True Original Parts. Whether you're working in one area or across the country, you can depend on reliable parts service close to your job from your Allis-Chalmers Construction Machinery dealer.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS



CAL-WIC INDUSTRIAL SCREENS

Today, as never before, Cal-Wic Industrial Screens are being used in the expanding construction industry of America. Contractors know they can depend on Cal-Wic Screens because they are tailor-made for accurate sizing and long life, resulting in less downtime and greater production.

Every phase of production of CF&I Cal-Wic Industrial Screens is checked by exacting quality controls to assure that highest standards are maintained. The steel used is specially-selected, basic open hearth steel which has the right balance between hardness and toughness. Cal-Wic Industrial Screens are then woven on powerful looms. They have tight wire intersections and openings that will retain their original size.

There's a CF&I sales engineer always within easy reach . . . ready to give you prompt assistance with any operating problem that might arise. For complete details, contact our nearest District Sales Office.

CAL-WIC
INDUSTRIAL SCREENS
THE COLORADO FUEL AND IRON CORPORATION
CF&I

3612

Albuquerque • Amarillo • Billings • Boise • Butte • Casper • Denver • El Paso • Ft. Worth • Houston • Lincoln (Neb.) • Los Angeles
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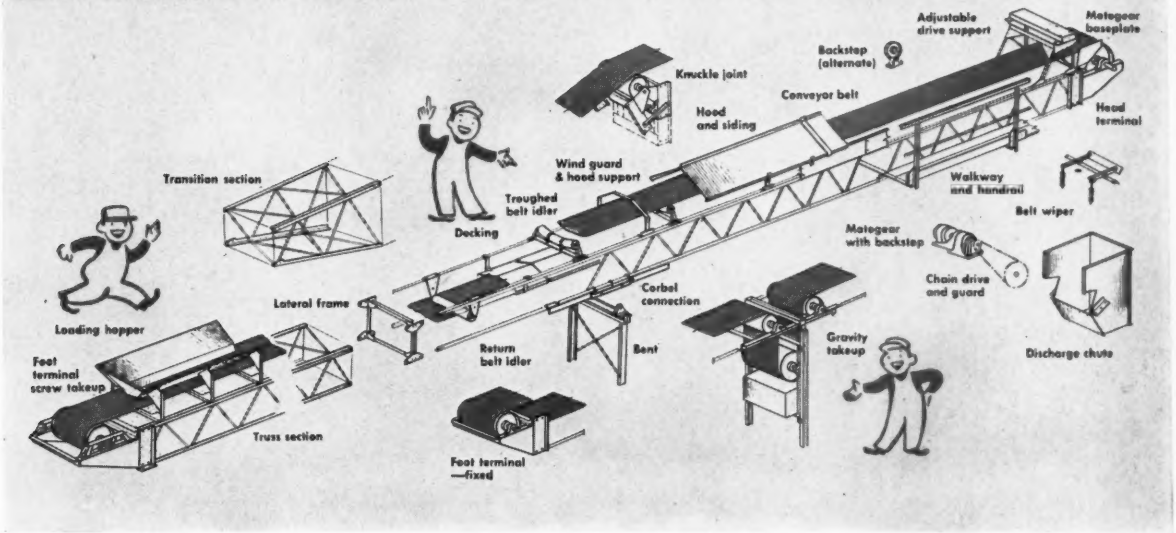
CANADIAN REPRESENTATIVES AT • Calgary • Edmonton • Montreal

THESE STANDARD COMPONENTS ARE ALL AVAILABLE TO MEET YOUR INDIVIDUAL REQUIREMENTS



NOW! The advantages of engineered belt conveyors in a LINK-BELT

PRE-BILT PACKAGE

easy selection

Your Link-Belt representative will help you select the best combination of PRE-BILT sectional belt conveyor components.

Standard 18, 24, 30 and 36-inch widths need no special engineering

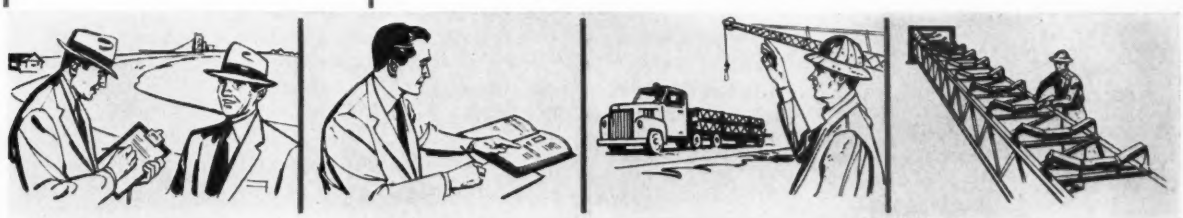
Here's an economical, standardized belt conveyor "package" . . . ready to meet the majority of belt conveyor needs and perform dependably for years and years. It combines standard Link-Belt products with sectional truss frames and steel supporting bents.

Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

LINK-BELT

14.114

BELT CONVEYOR EQUIPMENT



prompt quotations

He will prepare a comprehensive and accurate estimate of requirements for installations that permit "on-the-ground" survey.

simplified purchase

Parts are standardized, interchangeable, all available from one supplier. Link-Belt representative can furnish all data.

quick delivery

PRE-BILT conveyors are built at nine strategic locations throughout the country and are shipped from the plant nearest you.

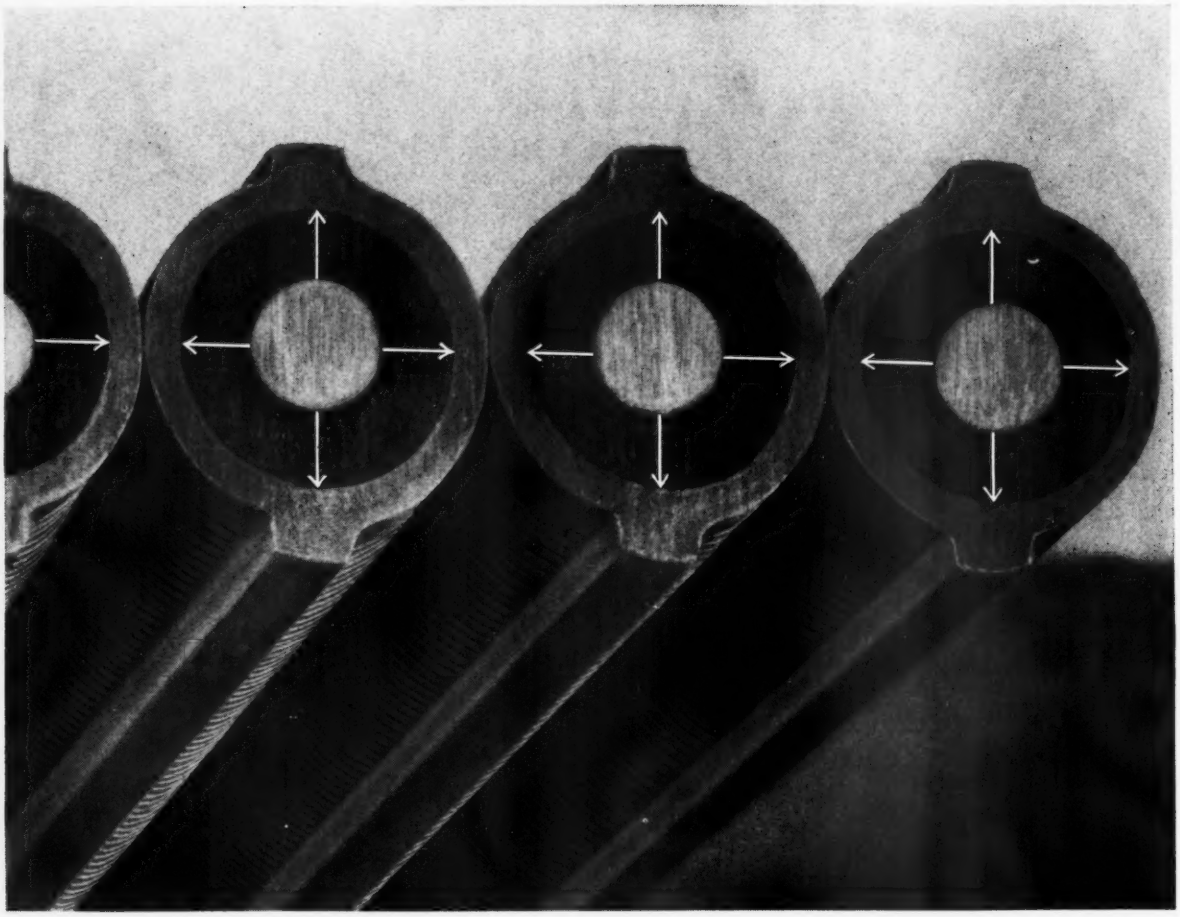
fast installation

Can be readily handled by your own erectors in most cases. Link-Belt can also furnish complete erection service and supervision.

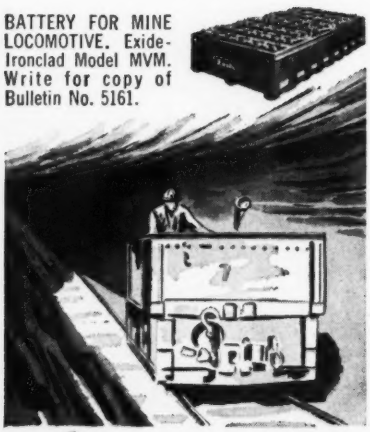
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

EXIDE-IRONCLAD BATTERIES

For all mining applications



Power tubes expand without shedding—preserve battery life



BATTERY FOR MINE LOCOMOTIVE. Exide-Ironclad Model MVM. Write for copy of Bulletin No. 5161.

Every time you discharge a storage battery, the active material on the positive plates expands. But the plate grids don't expand. This is basic.

On most batteries, the expanding active material tends to shear off from the nonexpanding grid every time the action takes place. But this can't happen in the Exide-Ironclad Battery. The reason is simple.

Active material is formed concentrically around the spinelike grid and held inside the plastic tubes. Expansion is predominantly in an outward direction—hence no shearing. Active material remains firmly locked to the underlying grid structure. And the flexible plastic tubes yield and take up as needed.

This extra protection against shedding of active material is only one of the many reasons for the long life of Exide-Ironclad Batteries. When you order heavy duty batteries, or the equipment requiring them, be sure to specify Exide-Ironclad. Write for detailed bulletin. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

Exide®

▲ Oversize pieces of limestone are readily pulled out of the blasted material and segregated for breaking.

▲ One of Tournatractor's jobs is moving equipment. Machine easily and quickly tows this heavy drill from one blast site to the next.

One fast rubber-tired tractor takes over all quarry clean-up ... speeds production

In Riverside Cement Company's limestone quarry at Oro Grande, California, there are many scattered jobs that must be done quickly, without interference to production. These jobs include clean-up around quarry shovels, leveling waste dumps, dozing overburden, towing other equipment around the quarry.

To do this variety of jobs at its Oro Grande property, Riverside Cement Company, of Los Angeles, first tried a 150 hp, 5.8 mph crawler tractor. They found the machine too slow. It couldn't get around fast enough to do its varied assignments.

More work done in less time

Recently Riverside Cement Company purchased and placed in service a 19 mph, 208 hp, rubber-tired Tournatractor. With the increased speed and flexibility of this unit, Riverside finds that critical jobs can now be completed in less time than before; eliminating production delays, cutting costs.

Big rubber tires "cushion" shock

Working on rocky quarry floor, the big, low-pressure Tournatractor tires absorb shock, ride smoothly over rough going, with minimum "wear-and-tear" to operator and machine. And Tournatractor's powertrain is sealed against quarry dust and gritty materials. Lubricants are kept clean and free from abrasives, damage and wear to bearings and moving parts is prevented, maintenance time and expense is reduced.

Investigate Tournatractors

For fast, all-around mine and quarry duty, investigate the highly maneuverable Tournatractor. Let us send you some owner-verified reports on Tournatractor performance. Write for full details.

▲ Tournatractor's 19 mph speed handles shovel clean-up in a hurry... cuts work delays... increases daily output. Rubber-tired tractor "outruns" crawler 2-to-1.

▲ Air compressors, and other mine equipment, moved fast from one job location to another. Tournatractor gets *more* work done, *fast*, at *low operating cost*.

Tournatractor—Trademark Reg. U.S. Pat. Off. T-872-Q-b

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

TOUGH HEAVY DUTY MINING CABLES *that have no equal!*

New SUPERTUF JACKET* makes
SUPER SERVICE MINING CABLES
tougher than tough

*General Cable's remarkable Flame Resistant SUPERTUF JACKET is a new neoprene compound processed for maximum lasting toughness, high density and tensile strength—*extra smooth* for wear, cut and tear resistance.

General Cable... *at your service!*

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N.Y. Offices and Distribution Centers Coast-to-Coast

Steep Rock Lake . . .

another example of how Bucyrus-Erie rotaries cut blast hole drilling costs

At Steep Rock Lake, 140 miles west of Port Arthur in Ontario's Rainy River district, Steep Rock Mines Ltd. recently replaced three cable tool drills with one Bucyrus-Erie 40-R rotary blast hole drill. Working in the dewatered Hogarth open pit section of the lake's basin, the electric-powered 40-R drills 7⅞-in. holes in high grade direct-shipping ore with an average iron content of 60%.

The cable tool drills were delivering 50 feet of 9-in. hole per 8-hr. shift. Average hole depth was 28 feet. Cost records for early stages of 40-R operation show that the machine has cut drilling costs per foot of hole (average hole depth is the same) by more than 50%. Here's the record for the initial 7-month period of rotary drilling:

Number of shifts worked	362
Total Footage 7⅞-in. hole drilled	59,406
Average footage per shift	164
Number of bits used (W7JR)	47*
Average footage per bit	1,265

* includes bits used for drilling quartzite seams.

This is just one of many case histories which are proving the drilling superiority of Bucyrus-Erie rotaries daily. Behind performance like this are these outstanding features: rotary drive with Ward Leonard control of rotating speed; hydraulically powered pulldown force; remote-controlled power-driven tool handling unit; and air-blast cleaning of drill holes.

For complete information on the 40-R, write today. Also ask about the larger 50-R machine for drilling 9⅞ to 12¼-in. holes.

35856C

BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

Expanded Facilities

for rebuilding your mining machinery

Completion of this 55' x 250' crane shop addition to our Bluefield, West Virginia, plant for rebuilding mining machinery assures you of complete service.

You can count on National rebuilt equipment for new machine performance at BIG savings

We provide . . .

- Thorough incoming inspection
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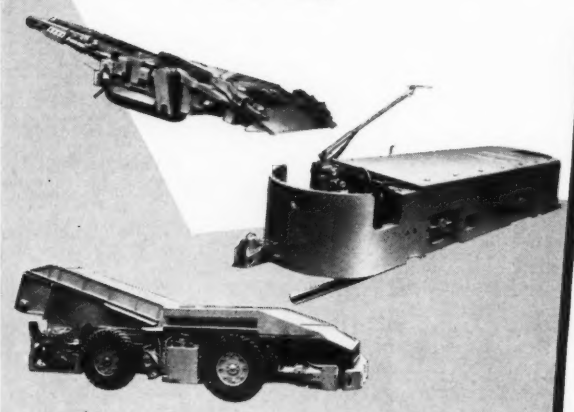

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COLUMBUS, OHIO
takes pleasure in announcing an agreement with
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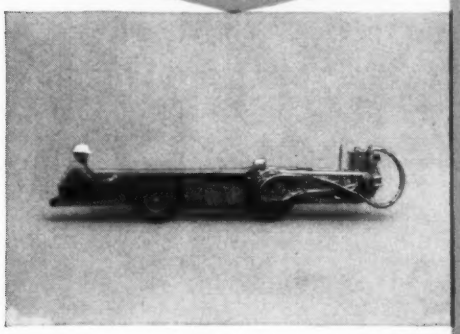
FOR STATIONARY AIR COMPRESSOR USERS...

THE ACME JUMBOLTER

Model HSJ



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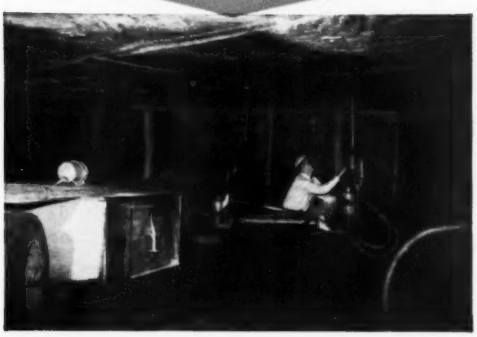
Time studies have proven that under most mine conditions the ACME JUMBOLTER installs roof bolts 3 times faster than hand held machines.



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The ACME JUMBOLTER takes the heavy lifting and hauling out of roof bolting. Finger tip control positions the stoper at any desired point. Two stopers will cover any point in a space 23' 10" wide without moving the JUMBOLTER. Arms reach 9' in front of the machine and swing 270°. No blocking is required for uneven top. Ample space provided to carry the day's supplies.

The ACME JUMBOLTER was designed to furnish a quick and easy method of drilling Roof Bolt holes where a mine is equipped with stationary or semi-stationary air compressors and having air piped to the working face. The unit is self propelled with full hydraulic drive and hydraulic steering. It is equipped with two stoper jumbo arms and is complete with stopers and dust collectors. Cleveland Model S11, Model S12 or the popular new Model S20 stopers may be used. All equipment is Bureau Of Mines approved. Best operating conditions in seams 36" to 108" high.

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ACME Machinery Company

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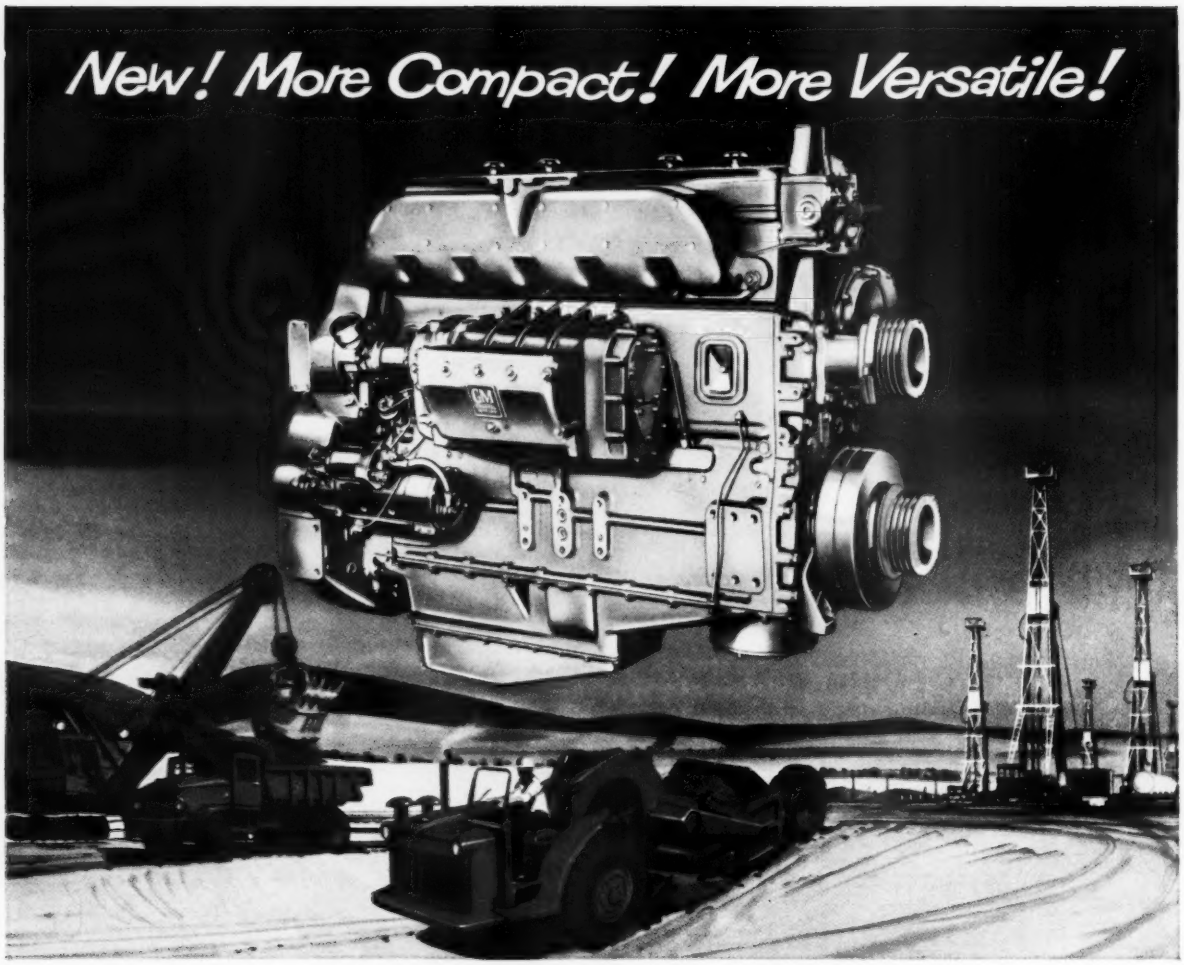

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Now available to fit a broader range of power equipment

Now the best 300-horsepower Diesel is even better than ever—ready to step up production and cut costs in any job you name.

It's the time-proved General Motors Series 110 Diesel, newly equipped with a side-mounted blower similar to the one used on the famous 71 Series. It's a more compact engine. It's shorter. It's lower. It fits more applications than ever before.

You can have this new GM Detroit Diesel Series 110 engine installed in off-highway trucks and move bigger loads faster.

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The new blower makes the Series 110 Diesel engine far more versatile—available with *either* right- or left-hand rotation, and wider range of accessory-drive outlets—*four* accessory drives on the rear of the engine and *four* fan-mounting positions on the front.

This new Detroit Diesel Series 110 engine takes on all comers in operating efficiency. It's a leader in work output per dollar. Let your local GM Detroit Diesel Distributor or Dealer show you what we mean.

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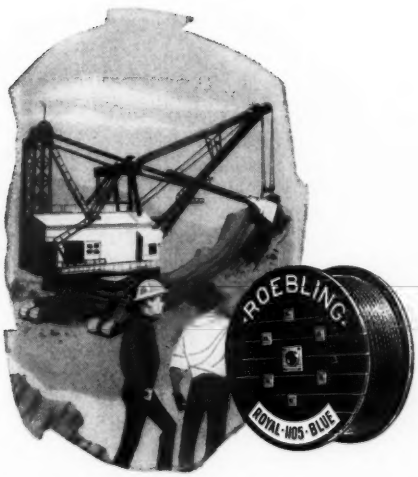
Royal Blue has won acceptance *faster* than any other wire rope in Roebling history



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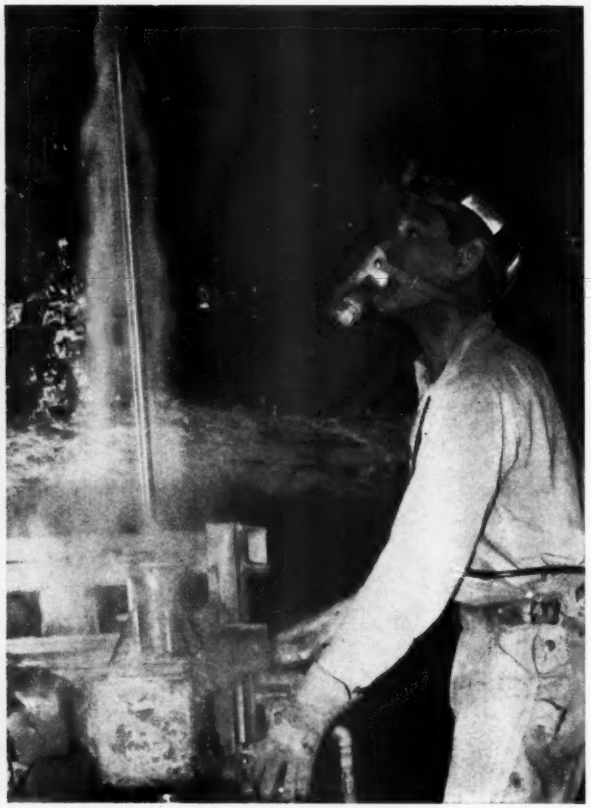

KENNAMETAL* DC-1¾ and FDH-1½ bits solve unusual roof drilling problem

THE PROBLEM: In mining fire clay at its slope mine in Cordova, Alabama, NATCO faced an unusual roof bolting problem. A 24″ seam of coal, the Upper Mary Lee seam, lies immediately over the 48″ vein of clay. This creates an unusual roof bolting problem, particularly since care must be taken that the clay is not contaminated by the coal, which is taken down only in entries and haulage ways.

SOLUTION: In rooms, Kennametal DC-1¾ bits are used to drill through the coal and Kennametal FDH-1½ bits drill 26″ into the slate and sandstone top. Kennametal PRSB Pinning Rods are used in both drillings. The 48″ roof bolts set on 4′ centers pin the coal to the top and, at the same time, control the roof.

In entries and haulage ways, after the coal has been removed, the slate and sandstone roof is drilled and pinned in the conventional manner, using the Kennametal FDH-1½ bits for drilling.

RESULTS: NATCO gets an average of 12 to 14 regrinds on the DC bits, which are changed once every two weeks, and 10 to 12 FDH bit regrinds, which are changed every 6 holes.

Using this combination, one man drills and pins an average of 60 holes in 7 hours.

No matter what your cutting or drilling problems are, you will find a Kennametal Bit to do the job fast, with low bit and maintenance cost, and long bit service. Discuss your problems with a Kennametal representative. Or write KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania.

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Ask about the Kennametal line of augers, pinning rods and accessories

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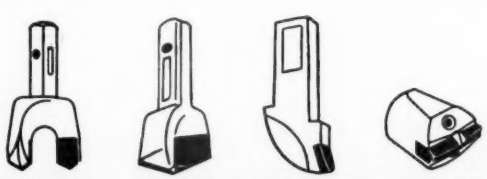


DRILL BITS ROOF BITS MACHINE BITS ROCK BITS

Editorials

ROBERT W. VAN EVERA, *Editor*

JULY, 1956

The Union Shop

THE May 22 ruling by the U. S. Supreme Court in the case of Railway Employes' Dept., A.F.L.-C.I.O. v. Hanson, Et Al. has established that union shop agreements under the Railway Labor Act are valid despite States' "right to work" laws to the contrary.

Organized labor looks on this decision as a victory that will lead to further advances of its cause. Most labor negotiations, however, are still governed by the Taft-Hartley Act, which specifically provides that a union shop agreement is binding only if the State law does not forbid it; thus the present right-to-work laws on the books of 18 States still apply for industries within their jurisdiction. The unions obviously would like to see Taft-Hartley changed—repealing the section recognizing the State laws and thereby making them totally ineffective.

It seems to us that any issue of labor versus management thus involved is unimportant compared with the basic issue of individual freedom. Donald R. Richberg, attorney of Washington, D. C., made some thought-provoking observations at a recent meeting of the U. S. Chamber of Commerce. He said:

"The wrong of compulsory unionism is completely ignored by those who argue that the main purpose of a union shop agreement is to eliminate the 'free rider'—to make every worker benefited by union activity pay his share of the cost. This argument is trebly false.

"First, the union shop agreement goes beyond requiring everyone to pay his share of union expenses and forces everyone to become a member, subject to his sworn promise to obey union laws and submit to union discipline.

"Second, the dues and assessments go far beyond the payment of collective bargaining expenses and provide payment for promotion and propaganda of the political and economic policies of the union, and for numerous outgoes covering such things as insurance and publications and entertainment which are outside the costs of collective bargaining.

"Third, the so-called free rider is in fact a captive passenger asked to pay a fare for a service he is compelled to accept. The unions have sought and obtained legislation providing that the representative of employes chosen by a majority of a craft or class can make an agreement binding on the minority of non-members who have not joined the union or otherwise chosen to make it their representative. The unions have sought and obtained such statutory authority because it was to their great advantage to prevent any minority or individual bargaining to change the terms of the trade agreement negotiated by the majority representative."

There are sincere and justifiable reasons why many workers may desire not to join a union. Should they not have the right to pursue that desire legally and without being subject to the penalty of loss of their jobs? All Americans have the opportunity to join —a church, a civic organization, a fraternal group, a club, a political party, etc.—and most of them do, according to their choice. They have an equal right to refrain from joining. Joining *by compulsion* is an outrage to our heritage of American freedom. Yet our laws, in the case of the union shop, are forcing workers to submit to this outrage.

Labor leaders have recognized and capitalized on one of the basic human characteristics —the "need to be accepted and to belong." Many workers, we believe, may enthusiastically join a union to satisfy this need. Such action strengthens the union's position and fills its coffers, whether or not it advances the cause of individual liberty.

The worker who rejects the human urge "to belong" in favor of his individual desire to think and act for himself is labeled a "free rider"—or worse. Actually, he is more captive than free and, as an involuntary rider, may be compelled to pay an exorbitant fare.

Trackless Mining of Trona

Nearly all equipment maintenance is done in one of the two underground shops. At proper intervals, the shop and stores area is moved to keep within a reasonable and practicable distance from the working faces

In 1938 Some 300,000,000 Tons of Minable Trona, a Nonmetallic and Relatively Rare Mineral, Were Discovered 1500 Ft Below the Surface in Southwestern Wyoming. Here Is the Story of the Discovery, Systematic Exploration, and Well-Planned Development of the Only Known Trona Deposit of Its Kind in the World. Of Especial Interest Is the Adaptation of Coal Mining Methods and Equipment to Yield an Average Output of About 40 Tons per Manshift for the Face Crew

By C. A. ROMANO
Resident Manager
Intermountain Chemical Co.

INTERMOUNTAIN Chemical Company's deposit of trona, a basic nonmetallic ore used for the production of soda ash, is located in the southwestern section of the State of Wyoming; specifically, near Green River in Sweetwater County.

Trona, a relatively rare, non-metallic mineral with the formula $Na_2CO_3 . NaHCO_3 . 2H_2O$, is an isomorphous compound of the normal and acid carbonates of sodium with two molecules of water. Pure trona contains 70.4 percent sodium carbonate and yields natural soda ash when heated so as to drive off carbon dioxide and water. The mineral crystallizes in the monoclinic system with tabular habits. The fracture is uneven to subconchoidal. Hardness ranges from 2.5 to 3.0, while the specific gravity ranges from 2.11 to 2.14. The mineral is characterized as dull, ranging from opaque to translucent with a color range of white to brown.

The deposit is unique from the standpoint of size and the fact that it is the only deposit of its kind known. There are unexplainable geological factors contributing to its formation which have resulted in favorable quality features over other known occurrences of trona.

The Green River deposits cover something over 30 square miles with an estimated tonnage in excess of 10,000,000 tons of minable trona per square mile. This raw material processed into soda ash, will yield upwards of 170,000,000 tons of soda ash —sufficient to supply the entire needs of the U. S. industries for close to 30 years.

Discovery and History

Soda ash is probably one of the oldest of the major industrial chemicals in use today. Its history goes back at least 5000 years as is evidenced by its presence in Egyptian tombs dating back some 3000 years before the Christian era.

Early glass and soap manufacture utilized soda ash, and today these two uses continue to absorb a large portion of the soda ash output. Other uses for soda ash include caustic and bicarbonate of soda, pulp and paper, non-ferrous metals, petroleum products, and as a prime ingredient in water softeners and household detergents.

The term "soda ash" originates

from the early source of soda ash which was from sea weed and plants growing along sea shores or near salt springs, which were subsequently gathered and burned to the resultant ash.

Over the years, as the need and uses for soda ash multiplied, production facilities and techniques expanded and were improved. For many years the main source of soda ash has been the synthetic method, otherwise known as the ammonia-soda process. It is significant that the Intermountain plant, utilizing the natural ore trona, is the first new soda ash installation to be built from the "ground up" in the United States in some 35 years. Its initial installation was designed to process about 300,000 tons of soda ash per year, an estimated six percent of national capacity.

The refining plant is located over the trona deposit on a 209-acre tract of land owned by the company. The surface operation or refinery covers an area of approximately 200,000 sq ft and consists of eight major processing buildings, an administrative building, power plant and communications center, and silo-type storage facilities.

This vast trona deposit was discovered in 1938 some 20 miles west of Green River, quite by accident, in the course of oil and gas exploratory work. In the early 1940's additional drill holes were put down to further prove the deposit and our company undertook the development of the ore body. This development led to the construction of the existing mine and refining facilities.

The main trona bed is located approximately 1500 ft below the surface and the thickness varies from 7 to 11 ft. The main deposit is intimately associated with oil shales, gray shales and bentonitic shales of the Green River formation. There are thin beds of trona above and below the main deposit. These thin beds have little, if any, commercial significance.

Although many theories have been offered, the exact mode of the formation of the trona deposits has not been concluded.

The main trona body lies in that part of the ancient Lake Gosiute which covered an area of some 30,000 square miles extending from Wyoming into Utah and Colorado. During the Eocene period, this lake was an impressive body of water; it lay near sea level and abounded with plant, animal and bird life. (We have had evidence of this from the fossils found.)

Natural waters, entering the lake, drained areas occupied by several mountain ranges. Drainage water probably carried heavy loads of salts into the lake. Evaporation taking place on the upper surfaces of the lake saturated it with sodium salts. Considering all the evidence, it seems that the trona had its inception from the reaction of solutions of carbonates of lime on analcite beds, and from the leaching of alkaline silicates by surface waters, the concentration of sodium carbonate in the lake, and finally the formation of the deposit. Aeons passed, the lake disappeared, climatic changes and geological upheavals occurred, and the deposit as we know it today resulted.

Surface Operation

The surface or refining operation requires roughly two tons of crude ore for every ton of finished product (soda ash). Rough crushed ore (minus three in.) that is brought to surface goes into stockpile or directly to processing. Basically, the process of converting trona to refined soda ash consists of removing impurities and rendering the raw material into a form such that water and carbon dioxide can be driven off by heat. Essentially, it is a refining process.

After thorough testing, roof bolting was adopted in 1949 as the standard method of roof support. Normal usage of bolts is currently running close to 80,000 per year

About the Author

C. A. Romano received his B.S. degree at the University of California and joined Westvaco, now a division of Food Machinery & Chemical Corp., in 1934. His present employer, Intermountain Chemical Co., is a unit of the Westvaco Chlor-Alkali Division.

In his association with the company, Romano has worked in laboratory research and development, engineering, mining, production, and administration. Besides special assignments in barium and phosphate operations, he has held the positions of superintendent at the magnesia plant, Newark, Calif., assistant to vice-president in charge of production in New York, and since 1948, resident manager of Wyoming operations.

Mine Production Personnel

The refining plant, for practical reasons, operates seven days per week. Through proper scheduling of working forces and the use of an intermediate stockpile on the surface, the mine is normally scheduled for a five-day-per-week operation with activities concentrated on the first and second shifts. Extra production shifts or additional maintenance are assigned on the third shift as required.

Refining operations require a mine output of about 2500 tons per operating day. This tonnage is currently being turned out with a maximum of five operating units. The fifth unit is not always used in production work, being diverted to other mine services as needed.

A standard unit or a crew, under the direction of a shift boss or unit foreman, is made up of 14 men. Productivity ranges from 400 to over 700 tons per unit shift depending on whether the unit is on development or extraction work. Average output of the face crew may run over 40 tons per manshift, while the over-all productivity including all mine production personnel runs over 20 tons per manshift.

Battery operated Scooters enable supervisory and technical personnel to cover the mine

The entire mine staff, including administrative supervision, clerical, engineers, miners, and maintenance, averages approximately 140 employes.

Mining System

The main trona bed was not entered until 1947, after the existing No. 1 shaft was sunk to the 1500-ft level. The intermediate years between 1938 (the discovery of the ore bed) and 1947 were absorbed in additional drilling to prove out the deposit and speculation as to the extraction method best suited to bring this raw material to the surface. Several attempts—all unsuccessful—were made to recover the trona as a brine from deep wells.

Contact with the main ore body through the No. 1 shaft soon revealed that trona could be properly mined by similar method or methods employed in many coal or salt mining operations. A development period ensued between 1947 and 1953, wherein low tonnage requirements permitted the defining of mining conditions specific to the deposit. This interim period also permitted research and engineering necessary to establish the refining process. Early in 1953, the multimillion dollar refining plant was put into operation. The mine development and expansion had kept pace with the surface plant, thus was ready to supply the crude ore requirements.

Development activities accounted for 100 percent of the ore mined until early in 1954, at which time the first regular extraction mining was started. Today, development continues to account for from 30 to 50 percent of production. After current work on main haulage and air drifts, to tie into No. 3 shaft, have been completed, normal development will drop to yield about 30 percent of ore production.

The mining pattern being followed is tailored for the ventilation plan with seven entries in the main development and four entries approximately ½-mile long in secondary development which connect with two entries serving as return bleeders. Presently, rooms are being driven 20 ft wide on 65-ft centers and no attempt is made to recover the ore pillars. Thees rooms are driven at right angles to the secondary development entries and are about 300 ft long. When sufficient air is available to handle the methane resulting from the caved roof, a regular, pillar extraction system with roof caving is planned.

The mine is completely trackless and is equipped with 36-in. belt conveyors for ore haulage and modified coal mining equipment in the working faces. Equipment has been generally "beefed" up in order to handle the heavier and more abrasive ore than the standard machines are normally called upon to handle.

Ventilation

The presence of substantial quantities of methane in the adjacent shales, which can be released upon caving of roof or heaving of floor, make it mandatory that a properly planned ventilation system with sufficient volume be used.

At the present time, the mine is ventilated by a five-ft Jeffrey fan, located underground between the two shafts. A volume of 120,000 cfm is circulated in the mine at about four-in. water gauge. Separate splits of air are maintained for each working area. Haulageways, conveyors, and powerlines are kept in the intake airways.

With the completion of the No. 3 shaft, the volume of air will be almost doubled with no increase in water gauge. Two 5-ft, Jeffrey fans in parallel at the collar of this shaft will supply the ventilating air for the entire mine. These will be pressure fans—making No. 3 shaft downcast. The choice of pressure fans was dictated by mining plans, necessity for heating intake air, and need for No. 3 eventually serving as the principal manway.

A bleeder system for return air with mined-out areas not being sealed is planned for the pillar extraction areas. This system is similar to that commonly employed in the gaseous, bituminus coal mines of West Virginia and Pennsylvania.

Auxiliary Transportation

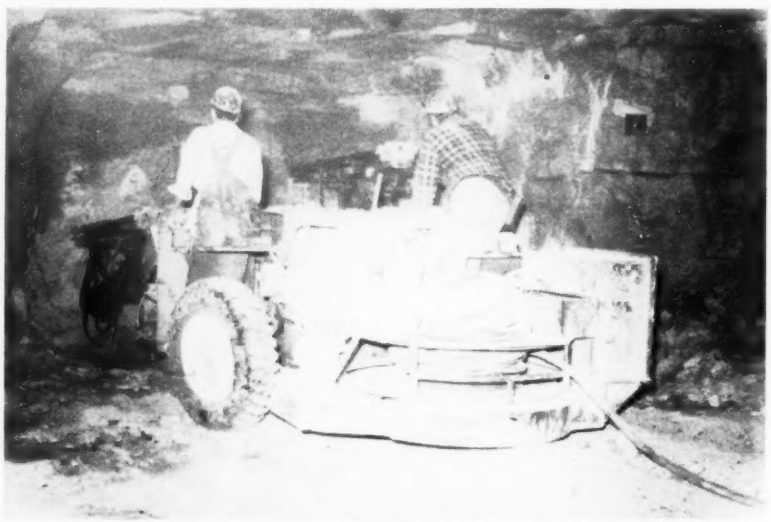
The mine is trackless throughout and thus presents a problem in the handling of men and materials. The problem is currently being handled by using electrified Willys' jeeps with rubber-tired trailers. The trolley system permits the use of shuttle cars for heavy haulage of materials and production equipment.

In service for supervisory and technical personnel are a number of battery-operated Victor Scooters. These Scooters are easy to handle and permit rapid coverage of all parts of the mine.

Power Distribution

The entire operation at Intermountain is self sufficient as regards power. Two 4000-kw steam operated turbines are utilized; in addition there is a tie-in with the local power company for limited emergency supply.

Power is generated and distributed at 4160 v. Special armored or shielded cable in each shaft transmits power to the mine area. Primary cables feeding transformers at the face areas are extended as the working places advance. These transformers reduce the voltage to 220. Circuit breakers protect the transmission system in the actual working places. All face and other equipment, with the exception of the shuttle cars, operate



Despite the hardness of trona, a drilling speed in excess of 10 fpm is obtained with these twin boom, hydraulically operated, rubber-tired units

at 220 v ac. The MG sets provide 250-v dc power for the shuttle cars, and jeeps are driven by motors of higher voltage.

Services

Except in rare cases, all equipment maintenance is done in one of the two underground shops. Stores or spare parts are stocked in the underground stores department. Due to the distances involved from the working faces to surface facilities, the above provisions have paid off handsomely. At proper intervals, the shop and stores area is moved to keep within a reasonable and practical distance from the working faces.

Undercutting

The preparation of a face employs a narrow horizontal cut at mid face in the foot wall. The narrow cut was adopted after full study of the physical and economic factors including depth of round, fragmentation, machine capacity, utilization of powder and crew time. Standard practice now calls for a 6-ft wide cut, 10 ft deep, in 20-ft rooms, while all other openings use a 4-ft wide cut.

The mine uses the Joy 10RU undercutter. It operates, as do all of the other mine equipment, with the exception of the shuttle cars, on 220 v ac. The unit is rubber tired and equipped with a ten-ft cutter bar. The bar and chain are made by Bowdil. The chain has double bit blocks, Kennametal U9H bits with tungsten carbide inserts, 117 bits per chain.

Although trona dust is neither dangerous nor injurious to health, it is controlled in all the operations. In this operation, spray nozzles are used to allay the dust. Joy Eugdusters are currently being adapted to each undercutter.

Drilling

The Joy CD-42 twin boom, hydraulically operated, rubber-tired drill has proven effective for trona drilling. Despite the hardness of trona, a drilling speed in excess of ten fpm is obtained. The number of holes per face varies from 18 to 33 consistent with the width of the face. Holes 1-⅝ in. in diameter and ten ft deep are drilled with Kennametal RD, tungsten carbide insert bits.

Blasting

Considerable study and research has gone into the blasting pattern used. Trona, as ore goes, is somwhat difficult to blast with satisfactory fragmentation. Fragmentation for sizing is not a real problem since all trona must ultimately be powdered for the refining process. The real problem resides with fragmentation with respect to pulling a proper round and with a minimum of large lumps which are detrimental to handling and wear and tear on equipment.

"Beefed up" conventional coal loading machines are utilized to muck trona

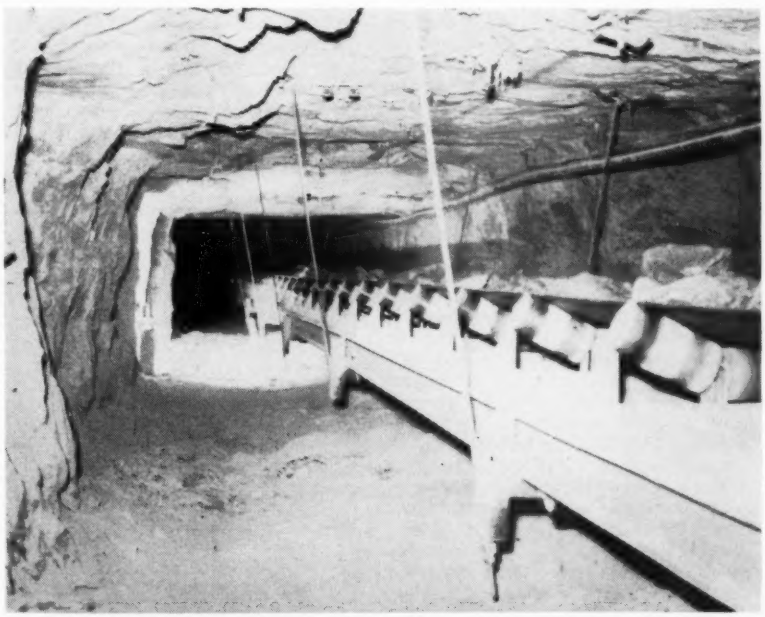
Cushion shooting is employed, using a 1 by 16 in. cartridge in a 1-⅝-in. hole. Low velocity (approximately 7600 fps) ammonia dynamite of 35-40 percent strength is used. Narrow work is shot with regular delay caps in six intervals; wide work is shot with Atlas "Rockmaster" caps in 11 intervals. Normally, advance averages 8.7 ft per round and a powder factor of about 0.90 lb per ton of trona is obtained. Firing is by duPont condenser discharge blasting machines.

Mucking

Conventional coal loading machines are adaptable to mucking trona after proper correction to cope with the heavier, more abrasive trona. The Goodman 665 mobile loading machine is standard in our mine. In a fresh muck pile these machines have a trona loading capacity in excess of eight tons per minute.

Shuttle Car Transportation

Ore is transferred from the working areas via Joy 10SC cable reel shuttle cars. Average payload capacity of these cars is 8.5 tons of trona. Haulage distance between working place and belt haulage transfer point is generally kept under 600 ft for reasons of efficiency. Normally, two shuttle cars are assigned to each working unit; however, conditions



Conveyor belt suspended from roof bolts. The mine is completely trackless and is equipped with 36-in. belt conveyors for ore haulage

Face preparation calls for a 6-ft wide cut, 10 ft deep, in 20-ft rooms, and a 4-ft wide cut in all other openings

often dictate better efficiency with three cars in service. The cable reel is used to power the unit for normal shuttle service; however, the mine is equipped with an overhead trolley system to provide power for general area coverage.

Roof Bolting

Trona exists in a horizontal bed averaging some ten ft in thickness. Horizontal sediments—shales and sandstones—lie above the deposit. Extending approximately 400 ft immediately above the trona are laminated gray shales of very little inherent strength. Directly under the trona is a bed of high grade oil shale which is susceptible to heaving as rock pressures adjust for openings. The peculiarities attending the rocks adjacent to the ore horizon posed ground support problems.

Conventional ground support techniques were used in the early stages of development. It soon became apparent that a study of ground support methods was necessary for reasons of safety and economy. In 1949, roof bolting was introduced in the mine on an experimental basis. The test period—under very close engineering control to follow such factors as sag, nut torque measurement, length of bolt, anchorage point and pull test—indicated very high promise of answering our difficult and expensive roof support problem.

In 1949, roof bolting was adopted as the standard roof support technique. A five-ft long, split-rod-and-wedge-type bolt was adopted as standard. Virtually, all known types of bolts and anchors were tested over the years past, but the split rod and wedge bolt continued to prove superior as regards holding power. An average load of about 17 tons is required to dislodge this type anchor or to break the bolt.

Last year, continued experimental work revealed that an expansion-type bolt gave results equal to or surpassing those obtained with the split-rod type. Results being equal, there are certain economic advantages attending the expansion-type bolt. Until such time as the conversion may be completed, both types of bolts are being used.

Spacing of bolts is on four-ft centers as a normal pattern in the mine. Bolts have been utilized in holding the rib, in the hanging of equipment and to stabilize the footwall. A substantial section of the main conveyor belt is suspended by roof bolts.

Self-propelled units—Joy WK-83—with attached compressor and two jumbo mounted stopers are used to install the split-rod, wedge-type bolt. The expansion-type bolts are installed presently with Joy RBD-8 type and the Fletcher type machines. Both machines are hydraulically-powered and self-propelled. One man operates the latter machines, while two are required for the former.

Normal usage of bolts is currently running close to 80,000 per year. Approximately 2,100,000 sq ft of roof is supported by bolts.

Conveyor Haulage

Intermountain Chemical Co. uses a 36-in. belt gathering system underground. At the present time, the main haulage belt is 6500 ft in length with individual segments of 3145 and 2950 ft respectively. Secondary conveyors —extending into the mining blocks— are 2600 ft in length, but are extended and retracted consistent with advance or retreat.

The shuttle cars discharge onto the secondary belt system through side dump stations mounted on threaded jacks and positioned to the belt at the desired location. The dumping stations can be moved and positioned readily. Transfer points, whether in line or at 90°, have grizzly slide sections which allow the finer material to form a protective layer on the belt. Impact idlers are used at all dumping stations and transfer points.

Main line conveyors are by Goodman Manufacturing Co., while secondary conveyors are by Continental Gin Co. Sealed bearings are standard on all rollers. Six-ply belting is used on the primary conveyor and five-ply on the secondaries.

The conveying system is designed to handle in excess of 350 tons per hour of material running from large lumps to fines. The units, or segments of conveyors, are powered by single-head pulley snub drive, 60 hp, 220 v.

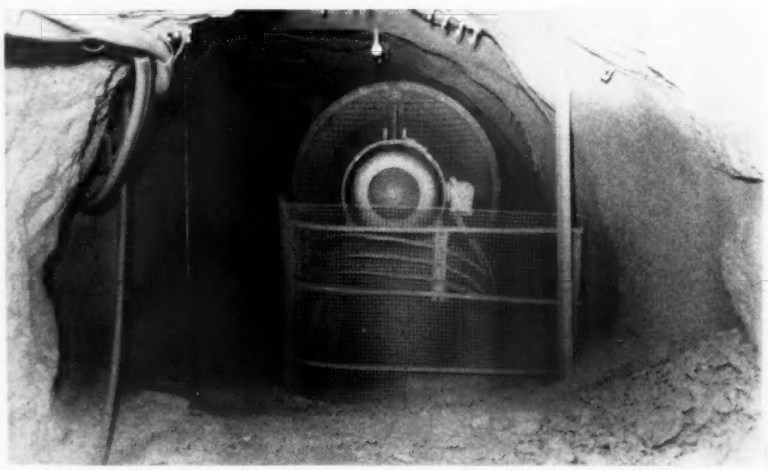
A slight incline of the main conveyor discharge allows the ore to discharge into a permanently positioned 21 by 60-in. single roll, toothed crusher, 100 hp, 220 v. The crusher is elevated so as to straddle a 36-in. drag conveyor which receives the ore crushed to minus 3 in. and conveys it some 60 ft into a shaft bottom pocket of about 800 tons capacity.

The ore pocket discharges into the hoisting skips through an apron feeder timed to fill automatically weighed hoppers which hold the exact load desired by the skips. This equipment is entirely automatic, but can be controlled manually if desired.

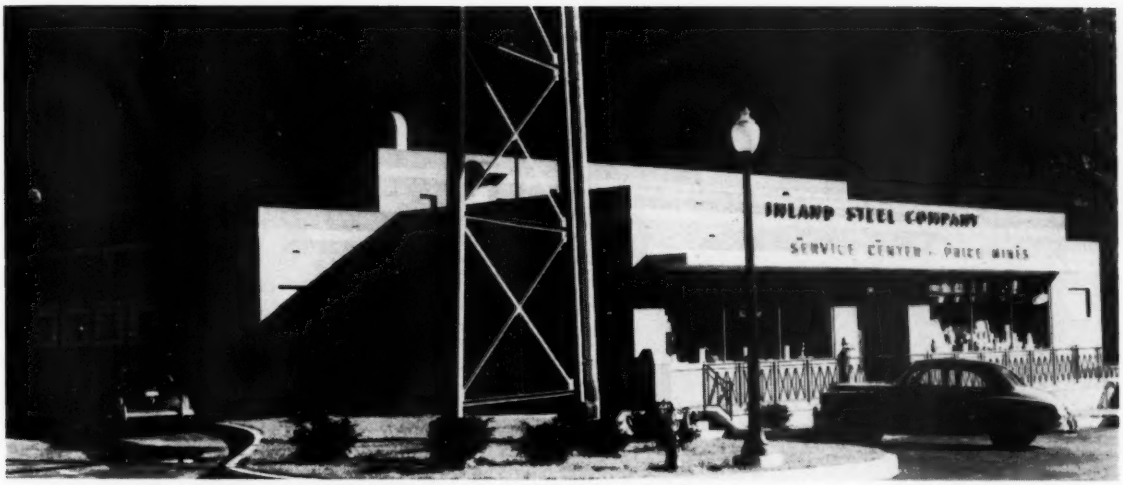
Shafts and Hoists

The mine is currently served by two shafts separated by some 1100 ft. A third shaft, to provide additional ventilation and future production ex-

(Continued on page 72)



The threat of methane requires a carefully planned ventilation system



The original one-stop shopping center, the industrial store, has kept pace with mine modernization

The "Romance" of the Industrial Store

By PAUL C. JAMIESON
Merchandise Manager, General Dept. Stores Div.
Eastern Gas & Fuel Associates and
President, National Industrial Stores Association

A COMPARISON of company-store operation in the old days with the new, modern concept of industrial store retailing reveals a vast improvement that matches the development of coal mining itself. Like the mines, the industrial stores have had to find better and more efficient ways of operating in order to survive. The fact that they are still very much in business testifies to their success.

Obstacles Surmounted

Gone are the compulsion and forced selling eras. Paternalism in the extension of credit with the resultant ever-increasing balances is a dim and distant memory. Over-pricing of merchandise today in the coal fields results in lost customers.

The lassitudes of the retail people of years ago have now turned to an aggressiveness matched only by the Nation's best retailers. Meeting and beating terrific competition that never existed in the past is an everyday occurrence in most industrial stores.

The new generation of industrial store operators has kept pace with the increasingly larger proportion of skillfull, intelligent, technically-trained engineers and miner-customers. Mechanization in mining has caused these things to happen.

Many obstacles in retailing in coal mining areas have had to be overcome. The stigma of inefficiency has been removed by personnel training, refixturing, better lighting and planned displays.

Today, in most cases, the miner owns his own home. He is a part-time farmer as well. His needs are many. He budgets his credit and cash very carefully. He travels on weekends in his new car, over good roads and shops and compares prices in the larger communities. He is aware of the newest things as soon as national publicity breaks—through radio, TV, newspapers and the many periodicals.

Competing for More Business

Mechanization has reduced the number of laborers and increased the number of skillful and well-informed workers in coal mining. Thus, industrial stores have had to improve their numerous style resources, varieties, prices, services and are now strictly competing for the entire potential retail business in a community. The professional man, the factory worker as well as the salaried man and farmer are all prospective customers. Also, many industrial stores are teaming up with hard-hitting distributors of merchandise so as to be first to launch the newest products in their respective communities.

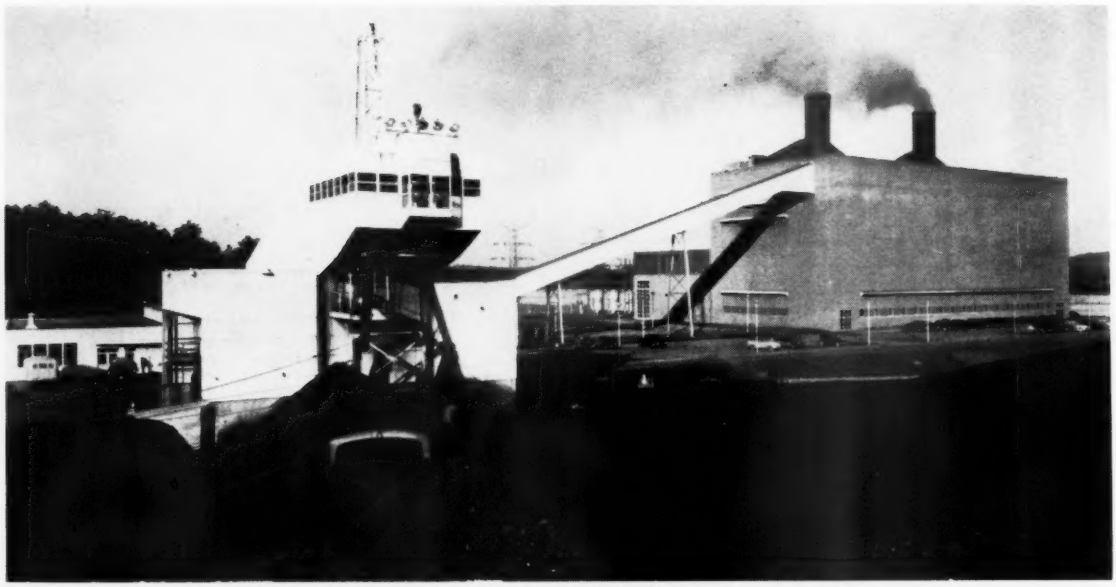
Publicity and advertising are the tools now being used extensively by industrial stores to create business. One popular method is radio saturation or the use of multiple spot advertising. Publicizing special prices over the air many times a day is enlarging the so-called geographical circle of customers trading with industrial stores. Television advertising is also used successfully. Coal field customers can measure values and if the industrial store meets the competition, there develops a sense of loyalty to the store, which definitely means more sales.

Future Possibility

Most industrial stores have always stocked their shelves with varieties of merchandise for the needs of the entire family. In other words, they are the original one-stop shopping center. Supers and large chains are just following in the footsteps of the industrial store by adding non-food items and various departments, so that they also become one-stop shopping centers. In order to keep up their sales and their sales positions, the super and chain are more and more reaching into the larger metropolitan areas. In towns of 5000 or less in population, the chains and large supers see little growth possibilities.

Since the industrial store seems to best serve the small community, let's say the community of 5000 and under, is it not reasonable to assume that an expansion of this type of retailing could proceed in the neglected 5000 population areas of this Nation? Progressive industrial store management might very well take over this "vacuum" in the distribution field, building a place for itself in serving those living in this large segment of the Nation.

A Look at Coal's Future



By 1960 electric utilities will be burning 200 million tons of coal annually

- **Market Promotion Paying Off**
- **Mergers Help Industry**
- **Electric Utility and Steel Expansion Programs Mean More Coal Sales**
- **Export Demand Solid for Some Time to Come**
- **Shortage of Engineering Talent Poses Big Problem**

By RAYMOND E. SALVATI

President
Island Creek Coal Co.

WE have recently witnessed important changes in the coal industry. Most of these changes have been for the better and have reversed the common belief outside the industry that coal was sick, to the point that we are now recognized as having a bright future indeed.

What has caused this reversal in thought and what can we look for in the future?

Internal cooperation within the coal industry has come a long way in recent years. A group called The Coal Executives Group has been organized, which consists of some 40 top executives in the industry. This group meets every two months to talk over mutual problems. Through this vehicle the coal industry has been able to analyze common public relations problems, and do something about them, more than at any other time in its history. This is a long step forward, something that should have been done a long time ago.

Market promotion is another field in which the industry is becoming more active. Efforts have been expended along this line in the past, but not to the degree that is necessary if we are going to get the story of the importance of coal across to the public with unqualified success. Through the Cabinet Committee on Energy Resources appointed by the president, through committees from our trade associations, and through the Coal Executives Group the industry has been telling its story. Those both in and out of coal now agree that for the first time the public is beginning to appreciate the importance of coal to this country.

Mergers and Consolidations

Much attention has been focused on consolidations in the coal mining industry lately, a move that I think is one of the finest things that has happened to us. There has been some talk, too, about whether these mergers and consolidations could be construed as a trend toward a monopoly. However, when one realizes that our largest coal company, Pittsburgh Consolidation Coal Co., represents only five to six percent of total production, it is quite evident that we do not have to worry about a monopoly in the coal industry today.

By comparison, one of the largest steel companies produces 35 percent of the steel production in the United States. It is doubtful that any coal company will ever reach that size but I predict that within the next ten years there will be ten or 12 companies producing a total of 150 to 175 or maybe 200 million tons of coal. The longer the picture is studied and the more we learn about future coal requirements, the more it becomes

evident that 175 to 200 million tons will be only a small fraction of the total coal requirements that will have to be met at that time.

Markets

This brings us to the very important topic of markets. The coal industry is selling energy, and energy demands are growing by leaps and bounds. Last year 140 million tons were used in the utility market. The rising standard of living in the United States is putting even greater demands on the electric utilities, which have experienced a doubling of size every ten years since World War I. People who know the electric utility industry best predict that the present utility consumption of 140 million tons of coal per year will probably increase to 200 million tons per year by 1960.

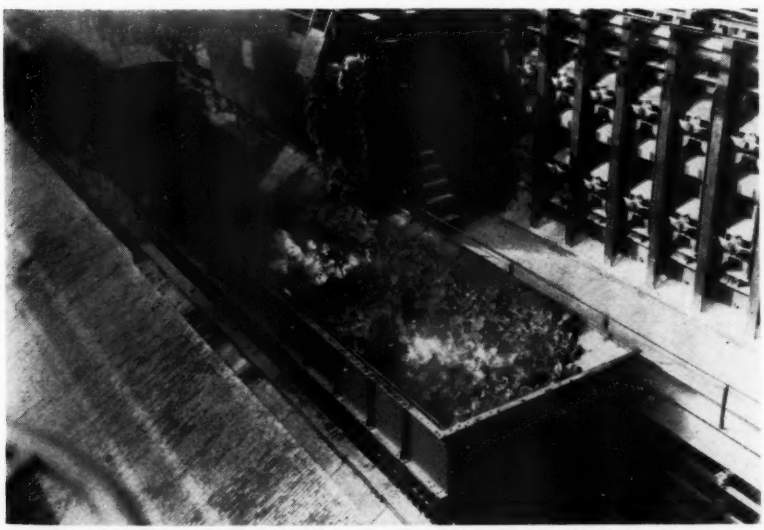
The utility market is not the only growing market either. Take a look at the expansion of steel. Millions of dollars are being spent for increased steel production capacity. This is even more striking when one recalls that only three or four years ago many people were crying that we had an oversupply of steel. The steel industry recognizes its responsibility and steel companies are going to spend nearly two billion dollars a year over the next three years increasing capacity from about 128 million tons today to 145 million tons in three years. What does that mean to coal? Assuming capacity operation, it means an increase in coal consumption by the steel industry of over 13 percent in three years.

Turning to the export market, it appears that that market can be counted on for some time. The dwindling rate of production in Europe and the tremendous activity of its various industries all point toward greater demands for imported coal. The stability of the export market is greater now than at any other time in recent history and in all probability it will be with us for many years to come. In 1955 nearly 30 million tons of coal were sent to the export market, excluding Canada. At the rate that coal was shipped during the first quarter of this year, it appears that exports will easily go to 40 million tons or better in 1956.

What has happened to the European countries? They have tasted better times and have sampled the American way of life. Europeans are getting electricity in their houses and they are buying refrigerators and other appliances. Wages are better and there is a general economic upturn, much faster even than our progress here. Coal cannot be produced in Europe to meet the requirements and when it is realized that the United States can put better coal along-side European docks at practically the same price as for coal produced there, the economics which create a steady demand for American coal, particularly for American coking coal, are easily seen.

The increase in exports, however, does not leave us without question marks. There is a transportation problem, boat-wise as well as rail-wise, and all elements of the coal industry have to join together—the railroads, the labor union, and the operators—to see if something can't be done about stabilizing boat rates. Long-term contracts had been made for as great a period as ten years. This pretty well indicates that there is a market which may go over 50 or 60 million tons by 1960.

All of the above factors, added to increases in demand for coal by general industry in this country, indicate that 500 million tons of coal, or a little more, will be required to meet demands this year. Production will undoubtedly reach the 600 million-ton mark by 1960.



Planned increases in steel production will bring a parallel rise in the consumption of coal by that industry

Expansion Needs

A very important question follows this last conclusion—where are we going to get the coal? New mines will have to be opened to take care of increased production demands and to replace current properties as they are worked out. This is going to take a lot of money, and it is quite evident that the industry is going to have to spend three or four times as much to replace properties now operating as they cost originally. Depreciation being charged against present properties will not come close to providing enough capital to open up new mines as their existence is called for. The industry is therefore faced with something of a paradox. On one hand it is striving for stable prices to meet competition from other energy sources; on the other hand it has to make sure that it has sufficient money to replace worked-out mines and open

About the Author

Elected president of his company in 1949, Raymond E. Salvati has been an employe of Island Creek Coal Co. since his graduation in 1922 from West Virginia University where he received a degree in Mining Engineering.

Starting as a track man, he was promoted to mine foreman within a few months and a superintendent over five mines in 1924. In 1928 he was named general manager of Pond Creek Pocohantas Co. and in 1932 was elected a vice-president and director of Pond Creek. Without giving up his early responsibilities, Mr. Salvati became general manager of Island Creek's operations in 1936 and was elected vice-president of Island Creek in 1940 and a director in 1942.

Mr. Salvati is also a vice-president of the American Mining Congress, and a director of the National Coal Association, and the National Association of Manufacturers.

This country's engineering and management talent has done an outstanding job but faces an even greater task in raising efficiency of the industry

new ones. It is a problem that faces everyone in the industry.

A Shortage of Talent

There is another issue that faces us squarely—the requirements for engineering talent. In the face of growing needs for engineers in all parts of industry, there has been a gradual decrease in the number of engineering graduates. Something has to be done to encourage more people to go into engineering and specifically, of course, to go into mining engineering. These men are vitally needed by the industry to help meet requirements which face it now and will face it to even a greater extent in the future.

Today's engineering and management talent in the coal industry has done an outstanding job, but faces even a greater one if we are not to let this country down. It is apparent that we have the opportunity to do even a better job than we have done. The industry is making tremendous strides in increasing efficiency. A comparison of production rates for 1954 and 1955 show that production per man-day rose from nine tons in 1954 to a little better than ten tons in 1955, an increase of better than ten percent. As a result the industry lowered its costs and was able to get a fair price for its coal and enough money back to replace the tonnage mined. This, of course, is a problem that is inherent in our industry if we are going to stay in business. To meet future energy requirements we are going to have to produce more coal, and it is going to be up to us to be more creative in our thinking, to do a better job to increase our efficiency and to see that we have an eight or nine percent increase in efficiency per year.

In addition to money, it is going to take new equipment to make technological advances. Manufacturers of mining equipment play a most important part in the over-all picture in cooperating and working with the coal industry. By working together the coal industry, including manufacturers and suppliers of mining equipment, can meet the requirements made of us and meet them at a cost low enough so that we can sell our coal at a profit that will enable us to reinvest and continue to go forward in meeting the 600 million ton demand and possibly the 800 million ton demand we look for.

Big Changes Coming

In my judgment, the revolution that our industry has seen to date is nothing compared to what we are going to see in five years from now and in the five years after that. This is no time to get the idea that we can sit back and rest on our laurels now that things are so much better. The industry has done a better job than it ever has, but we are moving so fast that machinery that went in today will be replaced by machinery that will do even a better job. It behooves all of us in the coal industry to be alert and be creative in our thinking. The responsibility lies with us in the industry today to provide the coal for the future.

I would like to conclude—and I don't want you to think I am preaching to you—but this one little article reflects my thinking and might be of some help to you.

"The greatest discoveries will be made along spiritual lines. Some day people will learn that material things do not bring happiness, and are of little use in making men and women creative and powerful. Then the scientists of the world will turn their laboratories over to the study of God and prayer, and the spiritual forces which as yet have been hardly scratched. When that day comes, the world will see more advancement in one generation than it has seen in the last four."

A strong export market can be counted upon for some time to come as European coal production has risen only slightly in the face of a rising standard of living and increased coal consumption

Mining equipment outage time is lost production time

A Modern Maintenance Organization

By D. B. SHUPE
Superintendent
Eastern Gas & Fuel Associates

Mining Equipment Costs Have Risen as Machines Have Become More and More Complex, Making It Imperative to Keep That Equipment in Operation a Greater Percentage of Time. Here One Mine's Experience in Developing a Successful Maintenance Program Is Described Based on the Idea of "Fix It Now" as Opposed to the Old Method of "Patch It and Keep It Running"

IN the course of the past decade, the introduction of highly specialized mining machines to the coal industry has served to highlight problems in maintenance which have always existed to certain extents, but in many cases never seemed to carry quite the importance suddenly attached to them. Mechanization in coal mining was begun years ago and spread rapidly over the industry. As the use of tools, machines, and electricity increased, operating companies formed repair and maintenance organizations to keep this equipment in shape and running. They hired mechanics and electricians and supervisors who knew their work though not always familiar with mining problems. Repair departments became integral parts of all operating setups.

As mechanization spread, so did the machines grow more complex and the need for more specialized knowledge grew also. The huge cleaning plants of today gradually became necessary to improve product quality, bringing with them their specialized problems and the need for trained personnel to operate them. Complicated mechanical designs, electrical equipment and control, hydraulics and electronics were introduced to a vast industry previously almost dependent on human labor alone for its production.

In the course of these changes, plant managements did not always recognize the full importance of good maintenance as the amount of equipment increased. Their idea of maintenance was to repair a machine when it broke down, to rebuild it when worn out. Maintenance men were regarded as necessary evils, as parasitic nonproducers; only face men were indispensable, the remaining crews were trimmed and reduced whenever possible.

Economics Force Maintenance

Management also generally lacked knowledge of their equipment or of good maintenance practices. As the need for technicians increased, executives and supervisors were forced more and more to depend on the heads of maintenance departments for guidance and often serious conflicts developed between operating and maintenance departments due to lack of knowledge of each other's problems.

In addition to the more complex

Table I—DUTIES OF REPAIRMEN

FIRST SHIFT SHOP CREW	
1—Machinist	
1—Blacksmith	—Tools, drill augers, general iron work
3—Bench Repair	—General repair work, coal drills, hydraulic pumps, etc.
2—Repairmen	—Speed reducers, gear transmissions, wheel units, etc.
1—Electrician	—Wiring, rebuilds contactors, panel boards
1—Repairman	—Air tools, stoper drills, impact wrenches
3—Welders	—Rebuild and overhaul work
SECOND SHIFT SHOP CREW	
1—Electrician	—Wiring, panel boards and control work
1—Apprentice Machinist	
1—Welder	—Rebuild and repair
2—Repairmen	—General repair and spare units
THIRD SHIFT SHOP CREW	
2—Repairmen	—All locomotive maintenance while locomotives are not in general use

equipment involved, probably the most important other factor became that of time. Where coal production formerly was secured from great numbers of pick and shovel miners, it was now vested in relatively few producers and loading machine units. Never was so much dependence placed on one producer or one unit and the ratio of capital investment to producing units was increased tremendously. With mechanization, it became increasingly important that the fullest utilization possible be realized and the greatest single factor adversely affecting that use became breakdown time.

The economic and labor conditions of the past few years have finally forced mine managements to belated recognition of the value of good maintenance practices. Operators of continuous equipment, mining high tonnages from fewer than a half dozen units probably place a higher value on a unit of time than any others in the industry. Minutes of production time have become precious in the literal "survival of the fittest" fight in recent years. Mine managers, heretofore riding along on the knowledge and abilities of those placed in charge of the maintenance end of the business, have had to get into the job of learning maintenance for themselves in order to improve it. By and large they can no longer accept the idea that if the repairmen are sitting idle then everything is going in good shape.

Regardless of the point to which mining methods and projections are developed, the high efficiency attained by good crew training and management, or the thoroughness of good supervision, the equipment of today must run constantly in order to produce. Not only must machines be repaired in the shortest possible time if broken down, but management has learned that a better method of increasing productive time is through prevention of breakdowns.

Perhaps in the most difficult position are mines which by reason of seam conditions, height, etc., cannot utilize the newer types of equipment and must by necessity continue operations with so-called conventional mechanical units. Not only must they show immediate increases in performance per payroll man to compete with the inherent greater productive potential of continuous miners but must strive to attain further improvement to maintain their competitive position.

No matter how efficiently the mine labor force is organized, the mining planned, or the supervision directed, their equipment must keep running to hold production at its peak and enable further increases in performance. Generally, breakdown time is the largest single factor to be reduced to make for greater over-all production potentials. Attention to maintenance methods, therefore, becomes of prime importance in the struggle to compete and forge ahead of others' progress.

Organization Described

There is, in our company, a mine which offers a perfect example of the situation portrayed. Begun a few years ago as a new modern mine, the plant enjoyed only mediocre success until its management recognized the problems outlined herein. As competition and pressure increased, officials got into the very roots of maintenance problems in order to learn all they could about the causes of breakdowns. Although their planning of the mine, the methods used, and crew training was well done, breakdown time was taking an exhorbitant toll of the working shift and was obviously the greatest single factor to be studied for increased production.

Everyone, including the superintendent, delved into the problems, even going so far as to staying in with maintenance crews to fix equipment. All tried to learn every kink which caused loss of production time and earnestly set out to do something about correcting them. Out of their efforts gradually evolved a maintenance program which, with continued improvements, has become one of the most successful in our group of mines.

In reality there is nothing radically different in their maintenance organization than is usually set up at many other plants. The usual master mechanic or chief electrician is assisted by five subforemen as follows:

Shop Foreman—1st Shift
Shop Foreman—2nd Shift
Inside Maintenance Foreman—1st Shift
Inside Maintenance Foreman—2nd Shift
Inside Maintenance Foreman—3rd Shift

Although all are responsible to the master mechanic, the shop foreman on the second shift is placed not only in charge of the shop and outside maintenance on his shift but also in charge of the inside maintenance on both second and third shifts. He heads up repair work on the second shift during which coal is produced, and sets up the work of preventive maintenance crews on the third shift when no coal is mined.

For all repair and overhaul work done in the well-equipped outside shop, a total of 19 men are employed under the various shop supervisors as shown in Table I.

Note that these men are usually assigned particular jobs as their regular work and have therefore become specialists in their fields. The organization is flexible enough however, to enable concentration of manpower on rebuilds or overhauls if necessary or to catch up any particular emergency job which may arise. In addition it is standard practice to send any or all of the shop men necessary to assist the inside repairmen in the event of any breakdown which requires additional help.

Specific Duties Assigned

After much trial and error, the seven operating sections of the mine were each assigned a full time repairman on each of the two producing shifts, the maintenance foreman on each shift carrying one extra man who is assigned as needed.

For off-shift repair and preventative maintenance in the replacement of large components, a force of eight repairmen are employed on the third shift, also under the supervision of a maintenance foreman. These men are worked in pairs and are assigned work laid out by the second shift shop foreman after an analysis of reports turned in by the previous two coal producing shifts.

While discussing the inside repair setup an important point should be made here and it keynotes a carefully worked out part of the organizational plan of maintenance at this mine.

Responsibility of each employe engaged in maintenance is made clear, not only for what routine maintenance he is held accountable, but also to whom he is responsible.

This is seen to be doubly important because the section repairmen work directly for the section foreman. Such a setup came about as a result of management's realizing that many small items were not being caught before they caused real trouble. Also because too many repairmen were observed day after day in idleness because of conflicts between maintenance and operating ideas of when a machine should be stopped to be fixed. In addition, repairmen were seen to be idle even though a section might be operating short-handed because of absenteeism.

All inside repairmen were finally placed directly under the production foreman of each section. Each foreman is therefore held responsible for routine running repairs and adjustments as the need develops on his equipment. At the same time, it is up to him to work out with his mechanic a schedule for these repairs and catch the equipment at appropriate points in the producing cycles for lubrication and inspection.

Cooperation between maintenance men and equipment operators has paid off

To obviate any possibility of passing the lubrication buck, in the age-old conflict between night and day shifts, each shift was positively assigned certain equipment for greasing and the opposite shift serves as check inspector to be sure it is carried out. For instance, it is standard practice for the day shift to lubricate the right-hand shuttle car, the belt feeder and belt tail-piece. The second shift cares for the left-hand drive car, the belt head, etc. Both shifts grease the loading unit and cutting machine.

The section repairman also fills in for absentee face men, trades out tasks during lunch periods, or helps in any way the foreman can use him. As a result, the section crews help him in his work and the foreman owes him cooperation in planning his maintenance duties. Actually, the section foreman at this mine were responsible for many of the original suggestions which brought this system into practice.

For all normal running repairs, a standard kit of repair parts is kept on every section. Each section repairman is held responsible for checking his inventory for complete stocks and for reordering as used. Again the responsibility is clearly defined. As a double check, the shift maintenance forman constantly keeps an eye on the availablility of parts as he makes his rounds.

Cooperation Stressed

The maintenance foreman on each shift serves primarily in an inspection capacity. It is his responsibility to visit each section regularly, to check each unit, not only to determine if small running repair work and lubrication is kept up, but to anticipate serious trouble which might develop on any unit. His check includes observation of any conflicts between repairmen and producing foremen as well as pointing out jobs necessary and suggestions for improvement.

All his reports are turned into the shop foreman to whom he is responsible. Together with the daily reports from section foremen and section repairmen, the two lay out the assignments for the next shift and/or the third shift prevention maintenance crew. At this point it might be well to state that important work is not held over for the third shift as a standard practice. One of the most painful lessons learned to date is that patchwork to keep a unit going until the end of the shift seldom pays. "Fix it now" has become their byword.

As to on-shift breakdowns, it was soon learned that down-time could be reduced only through use of spare assemblies, that individual parts could not be economically replaced while the rest of the section waited. Accordingly management furnished complete spare assemblies for every type of machine in operation. Many of these units are kept at the belt head on each section or at points so centrally located that they can be gotten to the repairman before he can remove the defective assembly from the machine.

The haulage men cooperate by giving the "road" to shop men going into the mine or to repair units being taken to the section. Conveyor belts are emptied by the boom man in order to be ready to expedite delivery to the face. Management's insistence on cooperation and teamwork in repairing on-shift breakdowns and their planning to save every possible minute of production time has resulted in important gains in production and a spirit of no one sitting still until that machine is fixed.

One of the most important steps taken to reduce on-shift down-time, and with the same efforts effect sizable gains in the way of preventative maintenance, was the analysis of common breakdowns to decrease the possibility of reoccurrence or reduce the time required to repair them. For instance, through actually helping with the replacement of a long main hydraulic hose running through a loading machine frame, management was able to suggest replacement with double-strength pipe with easily accessible short hoses at either end. The net result was reduction of a two to three-hour repair job to 30 minutes or less.

The replacement of a certain cutting machine armature formerly required one to 1½ shifts of work; when management dug into the problem they expedited delivery of the replacement armature from the shop, furnished special racks for transportation on belts, sent shop men as a standard practice to aid the repairman and sent an impact wrench with the unit for removing and replacing the sizable number of bolts involved. The result was an average performance of two to 2½ hours for the same replacement.

Careful attention is also given to suggestions offered by the men, producers as well as repairmen. If an idea concerning altering a practice or redesigning certain components to reduce or prevent down-time merits action, management conscientiously follows it up, not only to take advantage of the potential saving but because of an earnest desire to keep all its men interested in maintenance. One loader operator suggested replacing as many Allen head bolts as pos-

sible with cap screws because the hollow heads filled with dirt and grease and required additional time and trouble to remove. Over a long period some regard this step as having saved countless shifts of down-time, though it appeared less than insignificant when first suggested.

Major Overhauls

Recognized as one of the most important steps in the program of preventative maintenance is the regular shopping of each piece of major equipment for overhaul or rebuild. Many operations schedule their overhauls on a tonnage basis or even on a maximum time worked system. Due to the belt haulage on butt entries and the trouble of moving heavy equipment back and forth in relatively low coal for trips to the shop, the management at this mine has set up a combination of the two methods. The development of every new butt entry is begun with a complete setup of overhauled or rebuilt equipment. As a result, when a producing section reaches the farthest extent of its entry development and begins retreat, the equipment is still in excellent shape for mining the major tonnage that is recovered in room work. When the entry is finished, the crew is moved to another butt already set up with rebuilt equipment and their old goes out for shopping again.

The end result of this program is that every piece of major machinery is put through the shop about every 12 to 14 months. Units from which maximum production is expected are simply not allowed to deteriorate to faltering, tottering condition before rebuilding; thus many serious on-shift breakdowns are prevented and a peak production maintained. For purposes of comparison with programs at other mines, the equipment averages 100,000 to 120,000 tons between overhauls.

Actually no spare equipment is kept available except that as the shop turns it out it is set up in a new location and perhaps for a few days or weeks it is at least partially available as a spare section. However, it is not standard practice to use it as such except in extreme cases.

Although the overhaul work involved in seven sets of equipment every 12 months may sound high in comparison with other mines, the problem is really simpler than it appears on the surface. With the number of spare subassemblies kept available and a spare gathering head and spare boom kept rebuilt and ready, it is possible to do a good, thorough rebuild job on a conventional loader in from five to six working shifts. A rubber-tired universal cutter requires about eight shifts depending on its condition. Again, all this work is pre-planned through inspection, and because of constant availability of spare assemblies and major components, is virtually finished before the old unit is brought out to the shop.

Value of Training

Probably the most difficult task in this entire maintenance program was in changing the thinking of the employes involved, particularly of the many section and maintenance foremen. Since a major portion of the system depends on the section foreman and the section repairman and their teamwork in planning lubrication and running repairs, these men had to be sold the idea of "Fix it Now" as opposed to the old method of patching and keeping it running. Management also found it necessary to teach that major repairs or replacements, though on the surface costing larger sums, usually paid off in extra production by elimination of delays common to gradually failing components or dragging, faltering equipment.

An excellent lesson to everyone concerned was the experience with shuttle car trailing cables. As in many other operations, shuttle car cables were made to last even after many splices, cable blowups and the sizable production delays which accompany these troubles. Management found that the foremen involved, even to the chief electrician, were actually watching their maintenance costs and were not asking for new cables because the initial outlay appeared too large to justify their request. None had accurately considered the cost of the delays experienced.

In an attempt to illustrate the faulty economics of such a dilemma, management placed two new cables on the section with the lowest production record. Total outlay involved about $600. The production increase in two days—four shifts—actually exceeded the cost of the two cables.

Maintenance supervisors must be taught that, within reason, money must be spent in order to make money.

Much has been done in the way of classroom training, also. Men are encouraged to attend instruction periods in blueprint reading and wiring. One of the large oil companies put on a course in lubrication of mining equipment. One of the most valuable classes to date was a course for section foremen, worked up and presented by the master machanic; it covered the common failures experienced on the particular equipment operated at this mine, how to watch for and anticipate the lesser troubles before real trouble is experienced. Lubrication was stressed by covering every grease point, exactly what it served and what could be expected to fail by passing it up. The change in attitude toward maintenance among the foremen was really surprising.

Men are encouraged to attend maintenance instruction classes

Although many improvements in mining methods, crew management, etc., have been made, improved maintenance practice is given the lion's share of credit for the steady increase in efficiency at this operation. In four years using the original equipment bought for initial mining, production has been increased from just over 2000 tons per day to almost 4000 tons with a 53 percent increase in production per face man.

Management has experimented with continuous mining but hard bands in the seam coupled with no margin of vertical clearance over presently available units have prevented any improvement over present mobile-loading methods. Therefore, at least until something suitable is made available, conventional equipment must continue to improve its performance. Mine management is not yet satisfied that potential capacity of present units has been reached.

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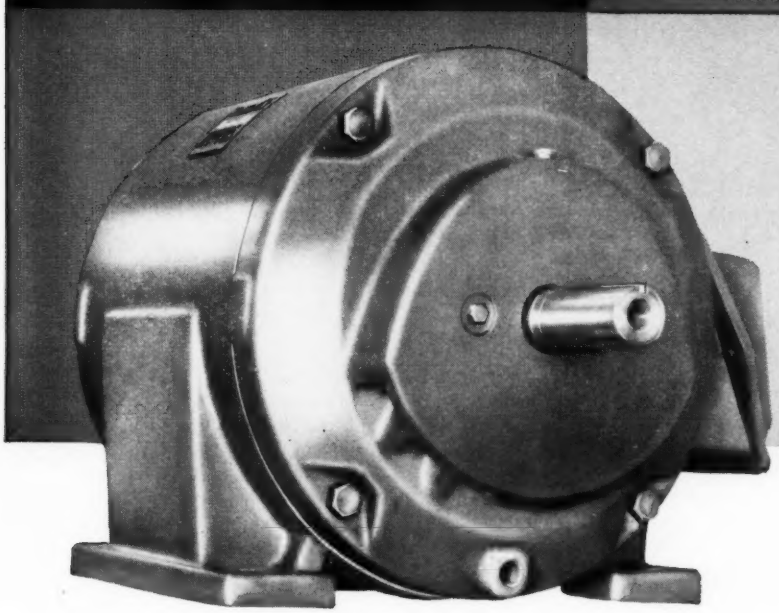

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The yieldable steel arch prevents roof failures in slusher drifts, thereby permitting elimination of much expensive branch raise development

Yieldable Steel Arches For Roof Support

By R. C. NISPEL
Underground Mine Superintendent,
Nevada Mines Division
Kennecott Copper Corp.

In Applying the Block Caving System at Its Ruth Mine, the Nevada Mines Division of Kennecott Copper Corp. Has Continually Had to Fight Problems of Dilution and High Development Costs Brought About by Heavy and Squeezing Ground. Yieldable Steel Arches Have Been Successfully Applied to Help Control Ground Failure and, According to Latest Reports, the Company Is Proceeding With Plans for Enlarging Its Arch Installations in Production at the Deep Ruth.

THE possibilities of yieldable steel sets for the development of the Deep Ruth Mine were recognized early by the manager of Nevada Mines Division who proposed that the Industrial Engineering Department make a thorough study of the applicability of these sets to our underground operations.

Representatives of the Industrial Engineering and Operating Departments visited several mines in which yieldable steel sets were in use. Several of these were the Cornwall mines of Bethlehem Steel Co. Pa., the mines of the Cleveland Cliffs Iron Co., Negannee, Mich., and those of the Lehigh Navigation Coal Co., Lansford, Pa.

Favorable Costs

Although none of the sets which were inspected had been installed for a sufficient length of time to present a complete picture of the over-all economy, we found that they have a definite application in heavy and squeezing ground such as ours and that the cost compares favorably with that of timber when the reduced maintenance and possibilities of salvage are considered. We were favorably impressed with the efficiencies of the sets to the extent of recommending them for trials in three slusher drifts in the development of our Minnesota Hi-Ore Body. A careful record of the action of these sets is being maintained during the life of the block. Also a careful record of costs is maintained for the same period of time. Supplementary reports are submitted by the Industrial Engineering Department covering conditions and costs.

To realize maximum efficiency from block caving, the uniform continuous draw of a block of ore must be maintained. Any deviation from the uniformity of the draw affects dilution of the ore, which in a marginal ore body can be disastrous.

Branch Raise Versus Slusher Drift Method

In our Old Ruth Mine, we used both methods in mining. It was established the branch raise and slusher drift

that although installation costs were higher for the branch raise system, maintenance costs were so much greater for the slusher drift method, due to inadequate ground support, that the over-all cost of branch raise mining was more economical. Consequently we used the branch raise method primarily, and relegated the slusher drifts to thin ore bodies and for cleaning up fringe ore.

Figure 1 illustrates the branch raise system as we have used it. In the event of timber failure at Square Sets A and R (taking the most extreme cases which occur) mining can be continued in the remaining 16 square sets while the A and R Sets are being repaired. This causes only a temporary loss of 12 percent of the ore in the panel and a negligible amount of dilution at Points 1 and 2.

Figure 2 illustrates the slusher drift super-imposed on the branch raises of Figure 1. Most apparent is the enormous amount of branch raise installation eliminated by this method. Timber failure at the same draw points (A) and (R) would result in a temporary loss of all the ore in the panel. While repairs are being made mining can continue in the adjacent panels, thus causing excessive dilution over the entire panel. This is shown at Points 1 and 2 in Figure 3, which is an end view of the slusher drift in Figure 2 and two adjacent panels.

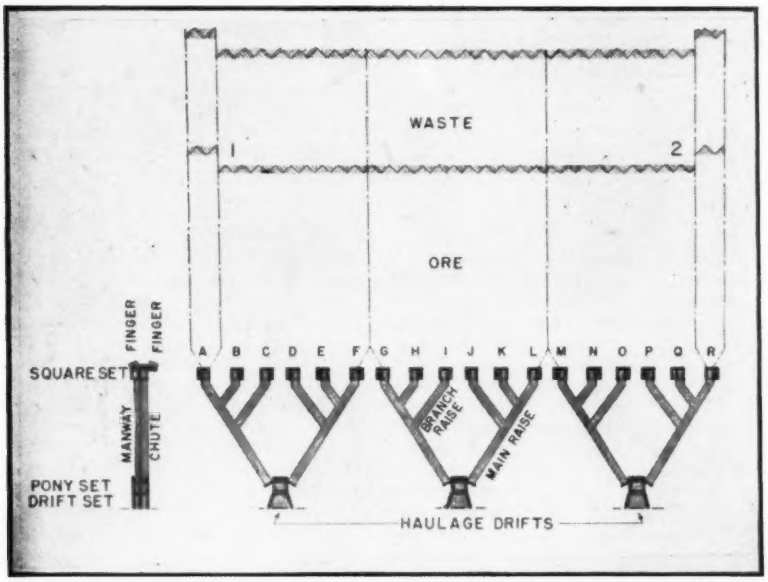


Fig. 1—The branch-raise method used in the past required a great deal of high-cost development, but was cheaper than maintaining the slusher drift by former methods of ground support

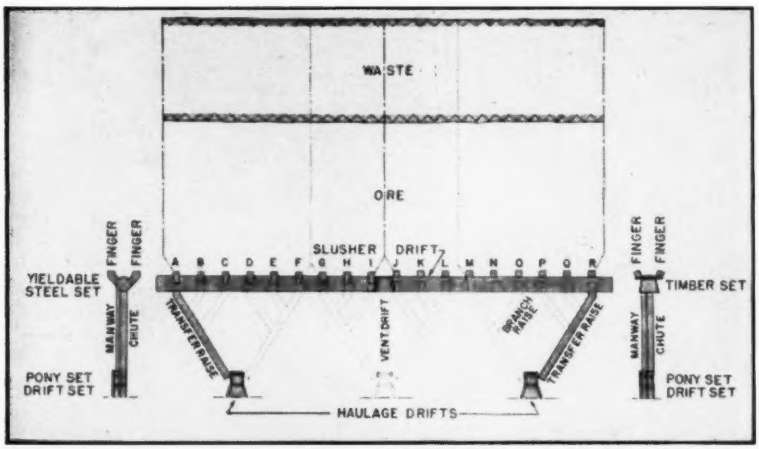


Fig. 2—The yieldable steel arch has eliminated failures at the draw points by providing adequate ground support—thus solving the problems of high maintenance costs, dilution, and interrupted operation. Timber failure at draw points A and R would result in a temporary loss of all ore from the panel

About the Author

R. Clair Nispel, a native Westerner, was educated in Colorado and attended the Colorado School of Mines. His broad experience includes work in the oil fields of Wyoming before joining the Kennecott organization in 1926. He has worked successively as rodman, sampler, assistant assayer, engineer, head surveyor, development engineer, general pit foreman and assistant open pit superintendent. In 1954, Nispel was made underground mine superintendent and has been assigned to the Deep Ruth project since the early stages of its development.

By replacing the timber in the slusher drifts with these yieldable steel sets, adequate ground support is obtained to reduce the high maintenance costs and facilitate continuous mining. Excessive dilution is thereby prevented and our problem is solved. The yieldable steel sets have proved successful in the three test slusher drifts in the Minnesota Hi-Ore, and it is now planned to mine the Deep Ruth ore primarily by the slusher drift method rather than the branch raise method.

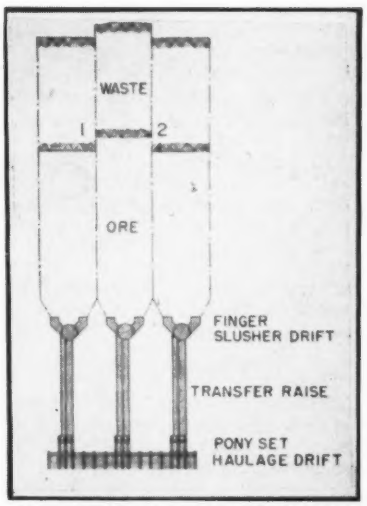


Fig. 3—End view of the slusher drift system shows how a failure at one draw point causes excessive dilution

Cyclone Classification and Thickening at Manganese, Inc.

Two Cyclone Installations Are Utilized at a Manganese Plant in Nevada With Gratifying Results. Eight 12-in. Cyclones Are Used to Classify 1200 Tons of Ore Per Day. Additional Cyclones Disperse and Thicken Manganese Concentrates. Performance Records on the Operation of This Equipment Are Presented Showing Both Its Capabilities and Its Limitations.

By S. J. McCARROLL
General Superintendent,
Manganese, Inc.

ALTHOUGH the cyclone principle is old the willingness to accept this machine is recent and the trend to use cyclones will become much more general with better know-how.

The cyclone will classify, deslime, dewater, grind, mix and disperse. Often these functions are so closely related as to overlap and the final product in one installation will not be the same as from a similar installation on a different pulp. The theory and mathematics of cyclone dimensions are well established but we still cannot predict accurately anticipated results.

There have been many excellent papers written on the use of cyclones for classifying and dewatering; some of the more recent ones were referred to when designing and operating the installation of Manganese, Inc. at Henderson, Nev.

The two cyclone installations at Manganese, Inc. will be discussed in this article. Eight 12-in. cyclones are used for classification. Four cyclones are operated in closed circuit with a 76-in. spiral classifier and 7 by 10-ft rod mill in each circuit. Feed pressure is 6 to 7 psi and volume of pulp 250 gpm to each cyclone. Approximately 92 percent of the overflow is minus 65 mesh. Cyclone characteristics are given in Table I.

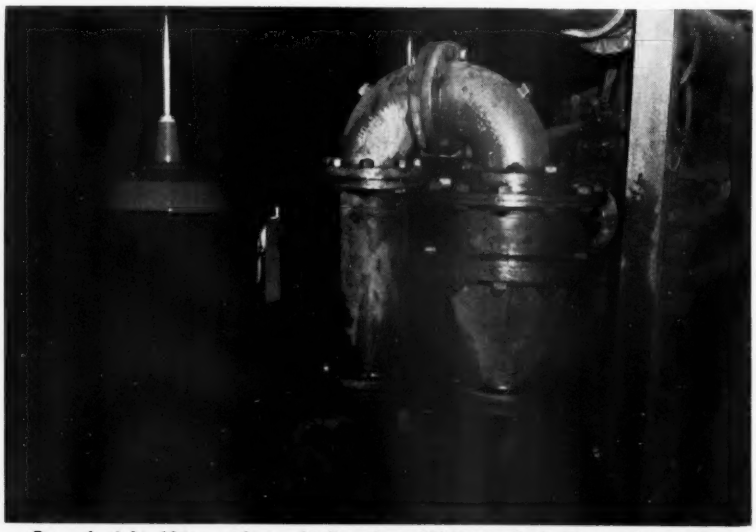
Plastic Pulp

This cyclone installation was made after the discovery that bentonite was causing erratic classification in the spiral classifiers. We have here a plastic pulp on which the centrifugal forces of the cyclone are more effective than gravity classification. Table II gives a typical screen analysis of the classifying cyclone products. In this table the cyclone feed is the spiral classifier overflow with 14.6 percent plus 65 mesh and 50.9 percent minus 200 material. The cyclone has reduced the oversize to 7.6 percent and increased the minus 200 mesh to 68.7 percent. This figure of 68.7 does not represent the true separation conditions but is a screen analysis of the overflow, and grinding in the cyclone has increased these fines several percent. With other conditions remaining equal, the plus 65 mesh in the cyclone overflow will increase from around 3 to 10 percent with an increase of bentonitic clay in the feed. This failure to give a sharp separation due to the plasticity of the pulp can be overcome by an increase in pressure.

Grinding Effect and Dilution

An increase in pressure brings attention to the grinding effect which is appreciable even on medium hard ore. This grinding effect may be greater than is realized, especially on a soft material. There has been little mention of this effect in recent papers and relatively no attention given to it when reporting cyclone performance. Cyclone pressure is usually increased with denser pulps for a given separation. While no data is presented here to show grinding effect due to pressure, Table III shows the effect of ore hardness on grinding and suggests that the increased grinding is due to abrasion of the particles of ore on each other rather than on the cyclone itself. An increase from 3.38 to 13.0 per cent in the minus 200 mesh cyclone overflow product is shown.

The rule that "dilution can usually be disregarded for purely practical purposes until the volume dilution of the feed drops below eight," will not apply in this case due to the plasticity of the pulp. The volume dilution should be more than eight in this case to give good separation and a minimum of overgrinding. The actual dilu-



One of eight 12-in. cyclones feeding four 8½-in. ten-leaf Oliver filters. The cyclones thicken and break up pellets or coarse flocs and deliver a homogenous pulp to the filter tank

tion volume is held to a little more than four to produce a pulp of 23 percent solids that can be treated in the flotation section without thickening.

An increase in the vortex increases the cyclone capacity with a reduction of feed pressure and sharpness of separation. It has been found that an air vent at or near the vortex discharge eliminates the vacuum on the discharge leg and tends to stabilize the flow through the cyclone. The absence of a vacuum on the discharge leg makes the apex adjustment less critical. As no air enters the apex with this arrangement the apex discharge may be either a whirling spray or rope although a rope discharge usually indicates the cyclone is overloaded.

Even though the overgrinding effect and dilution requirements of the flotation plant put these cyclones at the disadvantage of operating at a low pressure and low volume, dilution classification is far superior to gravity classification.

TABLE I
GRINDING CIRCUIT CYCLONES

	Each of 4
Feed, gpm	250
Feed Pressure, psi	6
% Solids—Feed	34.5%
% Solids—Underflow	56%
% Solids—Overflow	23%
Circulating Load	168%
Diameter	12"
Angle, apex	Approx. 21½°
Feed opening—Cross Section 3" diam with	1⅜" wedge
Overflow Opening—Cross Section (Vortex)	3½" round
Underflow Opening—Cross Section (Apex)	1¼" round

TABLE II
CYCLONE PRODUCTS

		Each of 4
Sizing of Feed (mesh)	+ 48	6.4
	+ 65	8.2
	+100	10.8
	+200	23.7
	+325	16.0
	—325	34.9
Size of Underflow (mesh)	+ 48	17.4
	+ 65	18.6
	+100	16.1
	+200	23.9
	+325	12.7
	—325	11.3
Size of Overflow (mesh)	+ 65	4.6
	+100	6.6
	+200	17.3
	+325	18.1
	—325	50.4

Thickening

The problem of thickening and filtering a highly coagulated manganese concentrate containing up to 400 lb of oily reagents per ton has been aided by the use of cyclones. This installation comprises eight 12-in. cyclones feeding four, ten-leaf 8 ft 6-in. Oliver filters. Two cyclones are used for each machine.

The cyclone feed is a slurry of manganese oxide concentrates of 28 percent solids. The concentrates are all minus 65 mesh with between 20 and 40 percent minus ten microns. The identity of the fine sizes is lost however, due to agglomeration with contained oil and soap. These agglomerations quite often reach the size of bird shot and may reach the size of marbles.

Operating results are the only indication of the value of this installation as the character of the feed and products makes sizing tests almost impossible.

The function of the cyclones here is to tear apart the agglomerations or pellets and to thicken. The cyclone underflow contains 36 percent solids and the overflow 20 percent of slimes which enter a 120-ft Dorr thickener and are then returned to the cyclones with the new feed from the flotation plant.

This arrangement has proven quite successful and while the problem at Manganese, Inc. is concerned chiefly with dispersing the agglomerations, the thickening which cannot be done in a conventional thickener is also effective.

Cyclones in conjunction with conventional thickeners will probably find wide application in preparing filter feed where segregation is a problem.

TABLE III

Mesh Size	Feed %	*Proportionally Recombined Overflow and Underflow*	*Deficit or Gain %*
Test 6-17-54 Feed 34.2% Solids—Hard Ore			
+ 48 mesh	21.69	21.07%	— .62
— 48 mesh + 100 mesh	29.72	26.62	—3.10
—100 mesh + 200 mesh	16.34	16.68	+ .34
—200 mesh	32.25	35.63	+3.38
Overflow: 32.9% by weight of feed—19.3% solids Underflow: 67.1% by weight of feed—55.2% solids			
Test 4-30-54 Feed 34.7% Solids—Soft Ore			
+ 48 mesh	11.30	7.94	— 3.36
— 48 mesh + 100 mesh	29.30	21.03	— 8.27
—100 mesh + 200 mesh	22.50	21.13	— 1.37
—200 mesh	36.90	49.90	+13.00
Overflow: 77.8% by weight of feed—29.6% solids Underflow: 22.2% by weight of feed—58.1% solids			

About the Author

Sidney J. McCarroll graduated from the South Dakota School of Mines & Technology in 1934.

Besides extensive milling experience in several western states, he spent 12 years in Peru, Mexico and the Philippines in charge of various mining and milling operations.

McCarroll has been with Manganese, Inc. as general superintendent since construction of the plant in 1952.

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Barge Loading Systems

The Economic Advantage of River Transportation Has Increased Activity in the Construction of Barge Loading Facilities. Two Prominent Engineers Discuss Recent Installations and Tell Why Specific Systems Have Been Chosen, Outlining Some of the Advantages and Innovations of Each

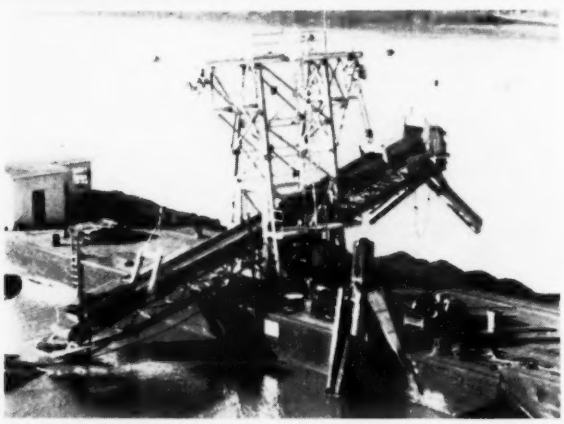
By D. H. McFADDEN
Assistant Chief Engineer
Ayrshire Collieries Corp.

WITH the demand for coal for electric power increasing nearly 100 percent in the last ten years (75,000,000 tons in 1945; 92,000,000 tons in 1950; and 141,000,000 tons in 1955), came the construction of more generating facilities at many different locations. When a navigable stream has been available, the railroads have been unable to compete with the barges in the transportation of coal. This fact initiated the planning of the two facilities to be discussed. At present, the rate per ton mile for rail haulage is about twice that for barge haulage. There is no prospect that the differential will decrease. To the contrary, it will probably increase.

Types of Loading Systems

Barges require a different loading system than the all-too-familiar railroad type layout, so a study was made of the several methods being used. All are the logical outgrowth of simply dumping the coal into a barge from above. These methods have been grouped into four types.

- **The stationary chute type**—the coal is dumped or conveyed into a stationary chute. This, of course, is the simplest and the lowest priced. The barge is moved underneath by winch or pusher boat. This type works very well where the fluctuations of the river are not great and large tonnages are not called for. A small floating barge with winches, or a pusher boat to move the barges to and from natural mooring places, and also to move the barges back and forth under the chute is needed for this type system. Small cost, small tonnages—limited to steep banks and minimum river fluctuations (that is, minimum at time of loading) are all advantages or disadvantages of the stationary chute type.
- **The elevating boom type**—the boom is raised up and down with the level of the river while the barges are being moved back and forth underneath by winch or pusher boat. This type system is usually equipped with a rotating chute so the barges may be



Barge loading systems divide into the four major groups illustrated above. Top left—stationery chute type. Top right—elevating boom type. Bottom left—floating barge type. Bottom right—tripper-conveyor type. Each has its particular application dependent upon such variables as fluctuations in water level, tonnages to be loaded, and bank conditions

loaded trim and to capacity and is just a little more elaborate than the first. An elevating boom allows for more loading time if the river varies greatly in elevation. The rotating chute allows for barges to be loaded better with more tonnage. The system is advantageous where the bank of the river is a considerable distance from the main river channel and the elevating boom and conveyor belt can be combined for travel across the flood plain.

• **The floating barge type**—the loading boom is supported on a floating barge and is easily oscillated to load a barge trim and to capacity as it is being moved by winch or boat. This system has the advantage of the first two types and allows access to the individual barges from the shore. A prerequisite however is a steep bank or the building of a fill to permit retraction or extension of the main feed conveyor belt with fluctuations of the river elevation. It is more advantageous where the barges are moved by winch because the winches and lines can all be at barge level. Some harbors have the floating barge without the pusher boat, with natural conditions of the river and the capacities of the harbor probably dictating the choice.

• **The tripper-conveyor type**—the coal is moved by belts to a cylindrical chute as the chute itself is moved back and forth endways and sideways over the barge. This system has all the advantages of the first three types and includes one more. The idea is that it is more economical to move the loading chute than to move the barges. In other words, winches or pusher boats are eliminated. Nothing has to be done to the barges except load them. Mooring lines are lowered as the barges are loaded. Tow companies remove the loads in a shuttle service and tie up the empties in a loading position.

The two systems to be reviewed were built by Ayrshire Collieries Corp. during 1953 to 1956. One is the Yankeetown Dock Corporation's facility near Newburgh, Ind., on the Ohio River. The other is the Gibraltar Coal Corporation's installation near Central City, Ky., on the Green River.

Both of these facilities are jointly owned by the Peabody and Ayrshire groups and were constructed to load coal for delivery by barge to the Ohio Valley Electric Corporation's generating station near Madison, Ind.

Yankeetown Installation

The barge loading system at Yankeetown is of the elevating boom type. This type was called for because of several conditions. Location of the coal field with reference to the river allowed only one or two sites for the harbor. The one in Pigeon Creek was eliminated because of the possibility of fill-up by silt and debris during high water. This factor also eliminated a canal-type harbor and a tripper type loader (as at Gibraltar). The floating barge type system was eliminated because of the added expense of grading and dredging an artificial island or bank at the river's edge necessary for high water operation on which to construct the retractable conveyor. Certain conditions could warrant this expense such as at Uniontown, Ky.

A large capacity harbor was needed to hold possibly three 15-barge tows, or 45 barges; therefore, several cells were called for. A conveyor belt was necessary to carry the coal across the flood plain of the Ohio River. It was essential that it be possible to load during moderately high water. Both of these conditions resulted in the elevating boom conveyor type being the most economical.

The cells could be used as a support as well as a mooring. One conveyor could do the complete job without any transfer points. The spacing of the cells was governed by the size of the barges to be handled. A barge being 35 ft wide by 195 ft long required the spacing near the load point of 97½ ft, or three cells for each barge; and away from the load point, a spacing of 195 ft, or two cells for each barge. The size of the cells was dictated by experience: 20-ft diameter for cells that would withstand rough service and take a terrific beating near the loading point; 16-ft diameter for cells that were essentially guide or mooring cells. The height of the cells was governed by the water levels. Pool stage is approximately 347 ft elevation and maximum flood stage is 387 ft, a 40-ft differential. Cells were built to a height of 389 ft, a two-ft free board above the all-time high water of 1937. The cells were designed and built on contract by Dravo Corp., Pittsburgh, Pa.

Aerial view of the Yankeetown harbor

Close-up of the Yankeetown harbor showing the elevating boom

Work Contracted

After the site had been chosen, property and riparian rights had to be obtained in addition to permits from the Corps of Engineers, U. S. Coast Guard, State of Kentucky, and two departments in the State of Indiana.

With permits, specifications and preliminary plans in hand, proposals were sent to four contractors for bids. McNally-Pittsburg Mfg. Corp. ultimately designed and furnished the plant.

The foundation was contracted for separately. Wood foundation piling was decided to be necessary after drilling and making load-bearing tests. Ryan Construction Co., Evansville, Ind., constructed the concrete foundations which were placed on wood piling. The most economical method to do the excavation and erection was with coal company personnel.

Results

The harbor design has worked out well. It was originally designed for the loads to be moved by cable only, the general movement of the barges to be downstream with the current. A pusher boat is used at present and the movement is upstream. No time has been lost because of high water though a 378-ft elevation flood occurred last year. Several barges have been lost by rough water caused by high winds from the west. The wind from that direction has about a 10-mile sweep up the river causing mammoth waves which have snapped ties and ropes and swamped loaded barges.

The original capacity of the facility was specified to be 800 tph of 1½-in. by 0 coal to be carried by a 48-in. belt at 410 fpm. As in every installation, this planned capacity has been increased. The system is now operating at a maximum rate of 1100 tph. The rotary breaker at the tail-end of the conveyor has delivered the desired specified coal.

The flow of coal has been well planned. Railroad cars are dumped into a 200-ton hopper by a rotary car dumper. The coal is then conveyed to a shaker screen in order to by-pass the 1¼-in. by 0 size. It is then transported to the breakers where it is crushed and the rock rejected, the coal dropping to an intermediate belt on which it gains height for a sampling station and a by-pass chute for truck coal loading. The river belt then coveys the coal directly to the barges.

The contracted tonnage of approximately 2,000,000 tons necessitates the running of two shifts for 200 days per year. These days and more are readily available, still allowing idle time for repairs, ice, high water, etc. The tonnage requires loading at night, which in turn, requires special lighting. The belt size, 48-in., was specified by the planned tonnage, and, of course, this belt size and speed governs the ultimate production possible.

Since being put into operation, the setup has been improved by a few innovations. These include a raising and lowering device for the tow cable, two takeups (some 28 ft of takeup necessary), and clamps on the tow cables.

The cost of the barge facility was about $700 to $800 per ton of rated hourly capacity. This cost includes only the 1100 ft of loading conveyor and the harbor facilities.

The Gibraltar Dock

The loading system at the Gibraltar Mine near Central City, Ky., is of the tripper conveyor type. This type was called for because of several factors. The location of the load point is fairly set as the nearest point to the coal field.

The size of the harbor was specified by the contract tonnage of 2,000,000 tons per year, the same as at Yankeetown. However, due to the daily shuttle service of the four-barge tows, space was required for only eight barges being loaded and for a few extras in emergencies, the plan being to make up the large tows after reaching the Ohio River.

As the Green River is fairly narrow, it was felt the harbor itself should be out of the traffic and the current. The Green River is different from the Ohio River in that it does not silt up.

These facts lead to an investigation of the economics of building a canal or slip for a harbor and shortening the conveyor. The canal idea proved to be the most economical.

The cells are 16 ft in diameter, 45 ft in height, and are entirely free to vibrate in any horizontal direction independently of the trusses. They are spaced at 97½ ft in order that 195-ft barges might be tied at three places. The harbor adjacent to the cells is 200 ft in width and will hold handily 16 barges, but only nine barges are necessary for the shuttle service of four barges a trip planned each day, seven days a week. The 5000-ton stock pile necessitates pit loading only four days per week two shifts.

Operation Described

The operator has control of the feed from the stock pile, the forward and backward movement of the tripper, the movement of the reversible shuttle belt, and the raising and lowering of the telescoping cylindrical chutes.

It is planned for the barges to be tied in strings of four on each side of the cells, the mooring lines to raise and lower with the barges and yet hold them snug. The conveyor belt is shielded from the wind by metal sideboards along the side of the conveyor.

Initial proposals were sent to eight different companies who bid on the loading facility, as well as the preparation plant. The McNally-Pittsburg Mfg. Corp. was the successful low bidder. The cells were contracted for on the low bid of Maxon Construction Co. in competitive bidding with two other companies. Permits had to be obtained from the Army Engineers, as well as the State of Kentucky.

As the facility has not been operated as of the date of this paper, the general idea has yet to be proven, but it is hoped that one man will be able (with full stock pile and tied barges) to load (2) shifts undisturbed, day in and day out.

View of the man-made Gibraltar harbor taken from one of the coal stockpiles

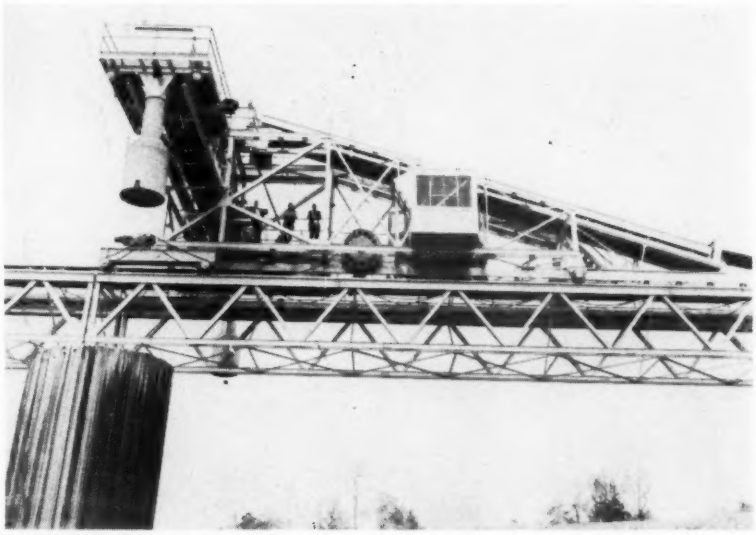
The flow of the coal to this facility is efficient. Raw Kentucky No. 11 and No. 12 coal is brought to the hopper by trucks on different shifts. The coal is stock piled separately after being run through a breaker to crush it to 4 in. by 0 size. Blending to the proper mixture of No. 11 and No. 12 is done by feeders at the bottom of each stock pile before the coal enters preparation plant. From the preparation plant, it is placed into a washed coal stock pile for direct delivery (on demand) to the barges.

The barge loading system, excluding the washed coal stock pile, costs approximately $700 to $800 per ton hour capacity.

Points to Consider

Barge loading systems are chosen by considering and studying many things. The most important ones are given below.

- **The topography of the site**—Does the location have high banks or low banks? Does it have a wide or narrow flood plain? What is the subsurface and foundation condition?
- **The characteristics of the stream or water**—Does the level fluctuate greatly? Is the current swift? Does the stream carry a large amount of silt?
- **The harbor capacity specified**—What area is needed for storage of empty and loaded barges?
- **The loading rate of the facility**—How many barges are to be loaded per day? Will this capacity require loading at night? Will it require loading at high water? In comparison with the hydrograph of the water elevations of previous years, what elevations will be the limits of operation for the facility for the required tonnage?
- **The specifications of the coal to be loaded**—Will the coal be constant size? Will it be wet or dry?
- **The prevailing weather conditions**—Direction of wind? Frequency of fog?



Shuttle conveyor at the Gibraltar dock. The operator has control of the feed from the stockpile, the forward and backward movement of the tripper, movement of the reversible shuttle belt, and the raising and lowering of the telescoping cylindrical chutes

The final barge loading system will be decided upon after considering all of these points and weighing them with the budget to be met. The final design will exemplify the solution to these problems with a flare of the imagination of the engineers concerned.

The two systems reviewed were conceived and built by the combined efforts of the staffs of the Peabody and Ayrshire groups.

Other Barge Loading Systems

By JOHN G. DONAN
Civil & Mining Engineer

A VARIATION of the stationary chute type one loading system, is an unloading bridge with a surge hopper and trimmer chute beneath. Such an installation is at Badgett Terminal, Grand Rivers, Ky., on the Tennessee River. The railroad facilities accommodate 390 loaded and 200 empty cars. The daily average loading rate since November 1951 is 300 cars with a maximum of 497 cars per day having been transferred. The location is in a safe harbor, with an inlet, or arm, of sufficient size to hold three barges—one loaded, one in the process of being loaded, and, an empty. The bridge spanning the loading point has a large surge hopper with a trimming chute, which also acts as a valve beneath the hopper. Switching is done by two Euclid tractors, which handle 12 car cuts. The barges are moved by 10-hp stalled torque hoist. Two 30-ft tenders handle empty and loaded fleets. These boats are equipped with 160-hp diesels with Algir rudderless drive.

The new dock at DeKoven Coal Mining Co., 20 miles west of Uniontown, is another example of a barge loading system that has been well planned. It is a near duplicate of the Yankeetown Dock facility.

Thorough Analysis Necessary

The planning and operation of these barge loading facilities, the two mentioned in this paper and those covered by Mr. McFadden, show to a marked degree that the situation has been fully examined and the solutions adequate.

All these plant layouts provide an efficient use of men and equipment so as to move coal over the shortest distance, while at the same time providing a natural sequence of operation, and the procedure is done in a safe manner in as near ideal conditions as possible.

In planning such a facility, a review of all the facts and recommendations is made of the composite layouts agreed upon in each instance, making certain that the desired objectives have been provided. The project is then closed and a budget cost estimate prepared on the agreed composite layout.

Anticipated savings in labor and material are calculated on an annual basis. The cost of the project is estimated in detail. From this, an analysis can be made to show the capital required; the return on the investment; rate of amortization; tax effect, and, anticipated profit. This will enable management to determine the extent to which the facility is justified.

Detailed geochemical and radiometric field measurements in a critical area near Moab, Utah, help to locate optimum drill sites

Trends in the Philosophy of Occurrence and Exploration For Uranium

A Notable Geologist and Engineer Presents a Possible Exploration Method for Discovering Deep Ore Bodies Which Are Beyond the Detection of the Geiger Counter and Lightweight Core Drill

By R. MAURICE TRIPP
President,
Tripp Research Corp.

MOST of the known uranium ore bodies on the Colorado Plateau have been found by observing an outcrop of mineralization or the chance encounter of mineralization by a shallow drill hole dug in the vicinity of favorable indications on a nearby outcrop. This technique has produced a substantial reserve of uranium-bearing ores, in fact, far in excess of what most people predicted could be found within the United States.

This method which has been singularly productive in the past has been gradually reaching a point of diminishing returns. A high percent of the outcropping, or very near surface, ore bodies on the Plateau have been detected by gimlet-eyed prospectors with the help of scintillometers and rotary drills. Within the last three years, no new major uranium discoveries have been made on the Colorado Plateau unless the recent discoveries in McKinley County, N. M., should prove to be of major size, in spite of the tremendously increased rates of exploration. These circumstances have led to serious thinking by many about the philosophy of occurrence of uranium and, consequently, what sort of exploration techniques will have a high resolving ability in the future.

Outcrop Discoveries

All of the ore bodies on the Colorado Plateau which have been developed so far are at or very near the surface. However, it is inconceivable that Mother Nature knew where the topographic surface would be in the middle of the twentieth century and located all of the uranium deposits in such a way that they outcropped or nearly outcropped. Therefore, we are forced to conclude that the enormously large expanse of otherwise equally favorable host rocks, which are deeply buried, have just as good a chance to be reservoirs for uranium minerals as those where Mother Nature has so kindly dissected them with canyons, arroyos, and gulleys so as to expose them to view. The diamond drill has been a valuable adjunct to the unaided eye and geiger counter by creating artificial outcrops for further examination. Many holes have been drilled for no other reason than that a claim was available, a drill had been purchased with money from enthusiastic stockholders, and it was necessary to report drilling results.

It is surprising how many Plateau ore bodies have been found with no more geological planning than the above. There will continue to be wildcat discoveries of this sort and they will probably bulk a fairly large tonnage in our total reserves. Thank goodness we have men of courage with someone else's money, who are willing to drill where good geological thinking does not indicate much favorability.

The era of the prospector with a jeep and scintillometer is not completely over and probably won't be for quite some time, but there is an increasing tendency to focus exploration thinking on how to find those big deep ore bodies which must be present, but are beyond the detection of the geiger counter and even the lightweight core drill. The general procedure has been to try and define the initial characteristics associated with the occurrence of an ore body and then devise exploration procedures to recognize those critical characteristics.

Occurrence

Let's begin by summarizing some observations: Most of the known uranium deposits are on the rim of basins in the vicinity of igneous intrusives. The regional warping, as well as local flexing and faulting, may only be coincidental, but in any event it seems to be an ever-present association and in all probability is of great importance as an ore control. Around many ore bodies, there is extensive evidence of alteration, leaching, or introduction of post genetic mineral. Several elements such as copper, vanadium, selenium, silver, zinc, tungsten, and others are found in greater than normal abundance in many Plateau uranium ore bodies. Organic trash is nearly always present in close association with the ore. There are more occurrences of ore in the poorly sorted coarse sands and conglomerates deposited during flood stages in ancient stream channels than in the rest of the formation. Massive sandstones are rarely ore producers. A preferred environment is the transition zone where sands and shales interfinger laterally. The normally red shales are partially altered to green in the immediate vicinity of the ore. Most of the larger ore bodies and ore producing distiicts appear to fall at or near the intersection of two sets of parallel lineations the most prominent of which strikes N25-30°W and is roughly parallel to some of the prominent structural features of the Plateau. The other set strikes about N15°E.

To these observations made at and in the vicinity of the presently known uranium deposits should be added the requirements which geological logic dictate must have been satisfied in order to have a minable concentration and tonnage of uranium mineral:

(1) There must have been an abundant source of uranium ions.
(2) There must have been a suitable host rock.
(3) There must have been a chemical and physical trap to effect localization and precipitation of the uranium ions.

There are several ways in which each of these requirements could have been satisfied and, consequently, a reasonable variety in the possible geological and geochemical details associated with the formation of an ore body.

Source

The primeval source for uranium ions is, of course, the igneous rocks and furthermore those rocks rich in calcium, silica, and alkalies have a much higher radioactivity than the basic ferromagnesian rocks. During the cooling of the magma, the U^{4+} ion along with the Th^{4+} ion tends to accumulate in the residual magma except for some isomorphic substitution such as zirconium in zircon and calcium in sphene and apatite. They cannot enter the aluminum silicate structure because of coordination number requirements. As the relative water vapor content of the cooling magma increases and the pegmatite stage is reached, sporadic precipitation of uranium and thorium minerals along with rare earths, niobium, tantalum, and similar elements is favored because of their low aqueous solubility.

If the magma becomes more oxidizing character at this stage, the U^{4+} may be oxidized to the U^{6+} state where it can form many water soluble compounds and is therefore free to escape from the magma with the hydrothermal solutions into the overlying and flanking rocks, leaving the unchanged Th^{4+} in the pegmatite phase. This explains the peculiar paradox observed in several areas where hydrothermal ore bodies have been formed, namely, that the source rocks will be less radioactive than normal.

Those uranium ions which do not escape before cooling and crystallization may be released later to the ground water by weathering processes. Some of these uranium ions get into

Poorly sorted conglomeratic sand with abundant organic trash and rapid lateral variation in lithology makes a good host rock

About the Author

R. Maurice Tripp was educated as a geological engineer at the Colorado School of Mines and later did graduate work and teaching in geophysics and geochemistry there before receiving an ScD in geology from M.I.T.

Dr. Tripp has been involved with mineral exploration problems in various parts of the world. Author of numerous technical papers on special methods of exploration, his principal activities have been concerned with the research and development of new methods of exploration for minerals.

He is currently president of Tripp Research Corp., Dallas, Tex.

the streams and rivers or eventually are carried to basins of sedimentation where they are precipitated with mineral and organic fragments. The subsequent erosion of these sediments may also release small amounts of uranium to the ground water and, particularly, in arid and semi-arid regions where the ground water is highly charged with alkali bicarbonates. Under these conditions, the uranyl ion forms a complex with the carbonate which is soluble at atmospheric temperatures and pressures.

In other words, it is possible to have uranium ions coming from hydrothermal solutions emanating from magmas and intrusives, from the weathering of uranium-bearing igneous, metamorphic, or sedimentary rocks, or from the leaching of uranium from sediments by circulating ground water. An additional possible source for ions would naturally be from the weathering or leaching of earlier formed ore bodies. It might be in order at this point to indicate the amount of uranium in the average sedimentary rock. A chunk of sandstone 600 ft thick, covering one square mile, will weigh approximately (5000 x 5000 x 600) ÷ 15—one billion tons. If the uranium content is two ppm, then there will be 2000 tons of uranium present. If two percent were leached out and subsequently precipitated in a volume of 10,000 tons of sandstone, the average assay would be 40 percent U_3O_8. This would be substantially better than the average ore body on the Plateau and would be attractive to most prospectors. The removal of only two percent of the indigenous uranium from the source rock would hardly be detectable except by high precision laboratory analysis.

Host Rock Requirements

A host rock must be sufficiently porous so there is an unfilled volume that the introduced mineral can occupy. Also, the product of cross-sectional area and permeability must be high enough to permit movements of very large volumes of solution through the formation. The solubility product of uranium minerals is sufficiently small so that enormous volumes of uranium-bearing solution had to pass through the formation to enable several tons of U_3O_8 to be left behind. Also, a suitable host rock must be one which is characterized by local deviations in the chemical and physical properties of the rock which will impede, restrict, or modify the movements of the solution or change its composition. A completely uniform, homogeneous, highly porous and permeable horizon would act only as a conduit and, therefore, be an unsatisfactory host. Some of the uranium from the transient solutions must be detained in order to effect local concentration.

The best host rocks, then, will be those which are characterized by rapid lateral change in sedimentation from coarse sands and conglomerates to shales and back again. This condition is commonly observed in poorly sorted continental deposited clastics. In some cases, it is probable that the uranium may have come from the clay and shale lenses where the ions were held by surface adsorption until the fluids were partially expelled from the compactable shales into the non-compressible surrounding sands.

The high porosity and permeability may be from primary causes such as the random packing of the sediment grains or from secondary causes such as solution cavities or fracturing and jointing.

Large scale regional flexing may modify circulation of rock fluids and concentrate them through a restricted zone thereby favoring local deposition

Trap

A trap is a combination of chemical and physical factors in the environment which restricts the migration of the uranium ions and effects local precipitation. Fracturing, faulting, or jointing are extremely influential because they provide a better channel of the circulation of mineral-bearing solutions and thereby bring into the immediate vicinity much greater quantities of uranium ions than normally would pass that way. On occasions, secondary cementation around fractures, faults, or joints may restrict permeability instead of improving it, in which case an impounding effect may encourage a reaction leading to the precipitation of uranium that would not otherwise have time to go to completion. Structural flexing and folding can have an important influence on circulation of ground water or on the direction of movement of invading hydrothermal solutions. Those areas through which large volumes of uranium-bearing solutions pass are most likely to be the locii of uranium accumulations. Consequently, any structural deformation which causes large volumes of subsurface solutions to funnel through restricted cross-sections creates favorable condition for the formation of an ore body.

Precipitation from Acid or Alkaline Solutions

Uranium-bearing solutions in nature may be either sulfate rich and acid in character or contain alkali bicarbonates and be chemically basic. Ore bodies have been observed that could have been brought in by either type, but it is probable that magmatic solutions are dominately of the acid type and that ground water in arid and semi-arid regions becomes charged with the bicarbonates which greatly enhances its ability to leach uranium from the rocks through which it circulates.

Uranium is precipitated by the acidic sulfate solutions when they are partially neutralized upon encountering calcite or dolomite. The sulfate ion is removed from solution as the insoluble calcium or magnesium sulfate and the subsequent increase in the pH causes a precipitation of the uranyl ion in a mineral combination dependent upon the identity of other ions present in the environment. It is a common observation to find gypsum and dolomite crystals abundantly distributed in and around the periphery of many uranium ore bodies.

Uranium being transported in ground water as an alkali uranyl carbonate complex is readily precipitated when the pH of the environment changes from above seven to just below seven. The increased hydrogen ion concentration destroys the carbonate complex and liberates the insoluble uranyl ion. The increase in the hydrogen ion concentration may come from organic acids, such as humic or tannic, associated with entombed or-

ganic debris in the sediments, or it may come from the oxidation of the ever present pyrite in organic trash to iron sulfate and its subsequent hydrolysis to iron hydroxide and sulfuric acid.

It should be stressed that the uranyl ion is not precipitated from an alkali uranyl carbonate complex when the pH drops from above seven to six, five, four, or even one, unless there is a mild oxidizing environment. This oxidizing environment is adequately supplied by ferric iron which, in turn, is reduced from the red ferric state to the green ferrous state. In other words, even though there were large volumes of chemically basic uranium-bearing solutions passing through a good physical trap where the acidity was sufficiently high to neutralize and destroy the carbonate complex, there would be no precipitation of uranium unless there were enough red ferric ions in the immediate environment, and if all this happened, the formerly red ferric ions would be left as green ferrous ions. Every Plateau prospector is familiar with the evidences of bleaching and alteration around an ore body. Oftentimes the more soluble, green ferrous iron will be partially leached away and the remainder hydrated to limonite giving the rock a rusty color instead of the usual red.

The presence of clays as intergranular filling often plays a remarkably effective role in causing precipitation. This is particularly true of the calcium and magnesium saturated montmorillonites. They not only impede the movement of the normal ground water circulation, but they also can remove the uranium by cation exchange and once precipitation is begun, further uranium probably separates out on the nucleii already formed. It is also possible, but not adequately demonstrated, that a hydrogen-saturated montmorillonite might be able to destroy the uranyl carbonate complex because of selective absorption of the uranyl ion releasing the hydrogen ion, thereby effecting further precipitation.

Conglomeratic channels like this one at the base of the Shinarump in Utah make good traps for uranium bearing solutions

Exploration Program

The steps in planning a mineral exploration program are:

(1) To observe where the known occurrences have been found,

(2) To recognize the controlling influences that caused them to be there,

(3) To design an exploration system that utilizes methods and techniques capable of detecting the presence of the ore body itself or the more usual situation of being able to detect evidences of the controlling influences that caused the ore to be present.

Most uranium finders so far have operated by step (1) and the first alternate of (3). That is, they have gone to the vicinity of a new strike and tried to find additional ore with a geiger counter or core drill. Most of the prospects amenable to that type of approach are rapidly disappearing and an increasing number of exploration-minded men are realizing the necessity for incorporating step (2) and the latter alternate of step (3) into their plans. This trend in thinking has developed as a consequence of realizing that all the uranium ore bodies probably don't outcrop and that there must be many environmental circumstances favorable for ore occurrence that are not exposed by current erosion.

The problem is how to select those areas which are sufficiently favorable to justify the expense of drilling a hole to see if ore is present. In other words, the drill is a device for making artificial outcrops and we need to upgrade the area first by geological, geophysical and/or geochemical means so that the drill under the most ideal circumstances becomes a device for determining the grade and tonnage rather than whether ore is present. There will still be many thousands of feet of shallow holes drilled for prospecting purposes, but when the targets get to be a couple thousand feet deep or deeper, the cost of each hole dictates that the operator be as sure as he can be that there really is a target before he spuds in.

The secondary antunite in the fissures and cracks of this shaft near Belmont, Nev., has come from the weathering of primary uranium contained in the granite country rock

A Suggested Procedure

The following procedure is suggested as a means of selecting areas for deep exploration on the Colorado Plateau and a means of upgrading them preparatory to investigation with a drill. It should be borne in mind that this is a major exploration effort intended as a bold approach to

(Continued on page 72)

A research worker emerges from a cloud of foam. Although his eyes have been protected by goggles and his mouth by cotton, this protection is not needed for short immersions in the foam

By W. J. WEATHERBY*

Domestic Detergents May Quell Future Mine Fires

Successful Experiments With New British System

BRITAIN'S Ministry of Fuel and Power hopes before long to have ready a new method of fighting haulage way fires in mines at long range. These "foam plug" experiments have passed several practical tests in a special tunnel at the Safety in Mines Research Establishment's station at Buxton, Derbyshire, and foam plugs have successfully been generated in more realistic conditions in a coal mine in County Durham.

The new method has yet to be tried out in a real mine fire, but the research staff is confident that after the completion of further experiments to improve some of the equipment, it will be capable of dealing with a fire at least 300 yards away in a matter of minutes.

So Simple, Yet . . .

Like many inventions once they have been thought up, the new method is so simple as to seem obvious, at least to any attentive husband whose wife uses detergents on wash-day.

P. B. Smith, a senior officer in the Fire Section at Buxton, got the original idea when he was studying then existing methods of fire-fighting. He mused, as so many had before him, on the difficulties of fighting a fire at long range. Collapse of the roof, excessive temperature, steam, or smoke, often prevent workers from getting close enough to use their water jets (it is generally reckoned that one has to be within 15 yards to be effective).

Even when they can reach it, the fire at the far end may be spreading much faster than it can be extinguished at the other. The common solution is to admit defeat and seal off the area with explosion-proof stoppings, but this is a confession of the inadequacy of fire-fighting methods underground and of the appliances that were originally designed for use on the surface.

Mr. Smith cannot now recall, much as he has been pressed by journalists for a human angle, how he first thought of the possibilities of generating a foam of air and water at a safe distance and then projecting it by the ventilation current into the fire zone. He has no stories of crying "Eureka" in the kitchen on wash-day. He put the idea to H. S. Eisner, then head of the fire section (he is now concentrat-

★ ★ ★

The article appearing on these two pages is the direct result of a photograph that ran in the March 21 issue of LIFE magazine. The editors of MINING CONGRESS JOURNAL were intrigued by the possibilities of the idea and arranged to have this special report prepared. Although the experiment has not been concluded, there is enough evidence available that would seem to make this unique method of fire fighting worthy of study in metal and nonmetal mines as well as coal. We look forward to being able to report in a future issue of the JOURNAL on the trial of detergents in mine-fire fighting in this country.

★ ★ ★

* An industrial writer on the staff of the "Manchester Guardian," England

ing more on the problems of coal dust explosions), who then devised a system for making the foam through a sloping net.

The Problem and the Solution

This was the problem they faced. In a fire zone bubbles are turned into steam which dilutes the oxygen of the air penetrating further into the zone. Flaming combustion generally ceases when the oxygen content falls below 15 percent, and if the foam contains one part in 1600 of its volume as water, the oxygen content will be reduced to 10.5 percent. It was, therefore, necessary to convert most of the air passing through the entry into foam.

The research staff stretched a cloth net (a commercial, lace-knitted, cotton fabric with holes about ⅛-in. in diameter and spaced about the same distance apart) across the entry, which has a cross-sectional area of 60 sq ft, and at an angle of about 45° with the horizontal. They then sprayed the high pressure side of the net with a solution of wetting agent (dodecyl benzene sodium sulphonate) in water through a nozzle consisting of many concentrically arranged impinging jets. The shape of the spray was a solid cone.

In subsequent experiments it has been found that the wetting agent should be used in a concentration of 0.3 percent by weight of the final spray liquid and should be introduced into the main water stream, from an ordinary mine fire-fighting hydrant, as a solution in water at the rate of three percent by volume of the final liquid. The proportioner used is a standard product, and uses the venturi effect to draw in wetting agent in the required proportion through a considerable range of pressures and flow rates. Water is used at a rate of about 60 gpm and a pressure of about 70 psi.

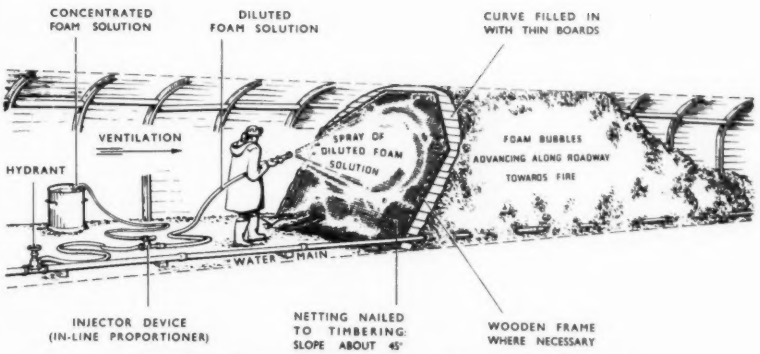
Engineers Were Impressed

I watched a demonstration with a group of mining engineers, including a mines inspector from India. Some of them were skeptical at the start, but they all came out at the far end of the tunnel obviously impressed.

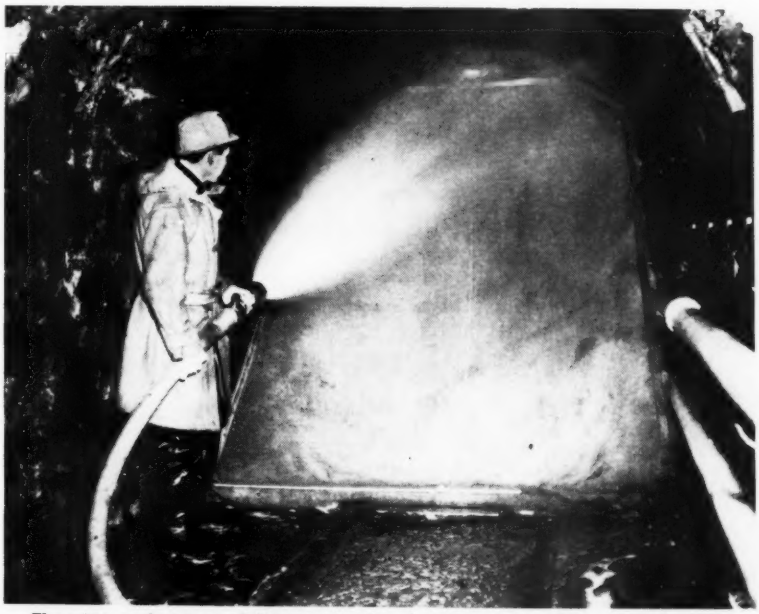
We stood on the low pressure side of the net and watched bubbles, carried by the air current, form and coalesce into a bubble mass which began slowly to advance down the entry towards us like some incredible monster in one of those science fiction films. The bubbles completely filled the cross-section of the entry and climbed over obstacles at a brisk walking pace.

Several of the inspectors stopped to get a better look and were quickly submerged by the foam. They were thus able to support the claim that

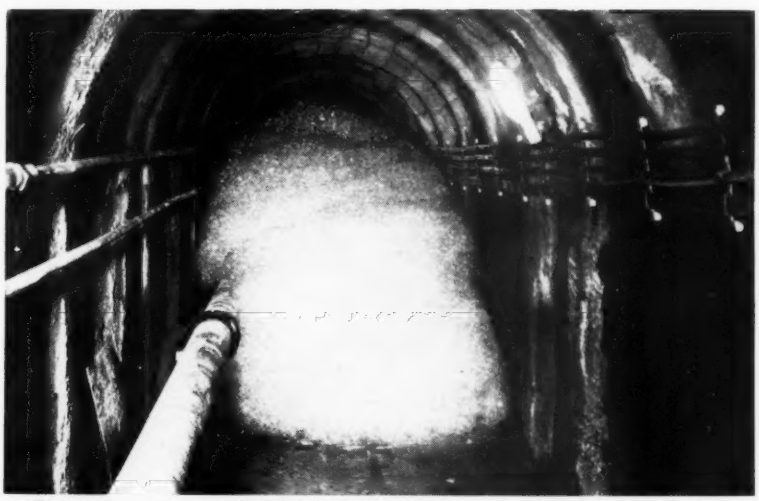
(Continued on page 68)



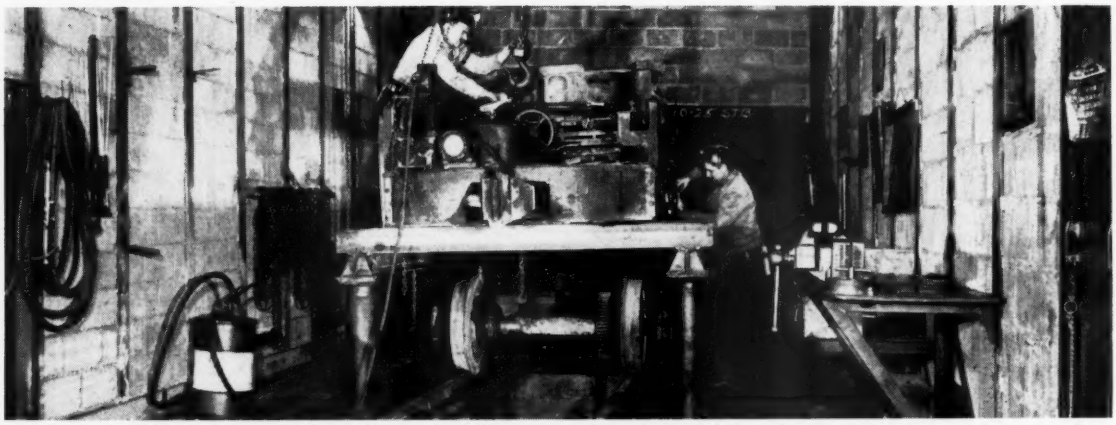
Experimental arrangement for fire fighting with foam plugs



The mixture of water and detergent is played on the net in a fine spray which, in passing through the net, becomes a mass of bubbles



Foam advance is controlled by the air velocity and the resistance of the entry. In experiments, observers have had to walk briskly to keep ahead of the advancing wall of suds



Bearings on mining equipment should be inspected during normal overhaul periods. On automotive type equipment such inspections should be made every 30,000 miles

Maintenance and Care of Tapered Roller Bearings

Regular Inspection, Careful Adjustment and Proper Lubrication Lead the Way to Improved Bearing Maintenance

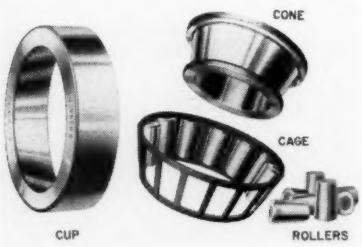
By ELMER ANDERSON
Service Manager,
The Timken Roller Bearing Co.

TAPERED roller bearings have been in use in American industry since 1899. Today they are giving dependable service wherever wheels and shafts turn. Such bearings are scientifically designed and precision manufactured, and require careful handling in maintenance.

Basically, there are four parts to a Timken tapered roller bearing—the cone, or the inter race, the tapered rollers which roll freely between the cup and cone, the cage, which serves as a retainer to maintain the proper spacing between the tapered rollers grouped around the cone, and the cup or outer race.

The cone, rollers and cage of a Timken bearing are assembled into a complete cone assembly in the manufacturer's plant and cannot be separated. The cone assembly fits inside the cup. The rollers revolve freely between the cone and cup. This, then, is a standard, single-row bearing which has been produced by the millions. It is called the type TS and is the most commonly used tapered roller bearing.

Sometimes there are applications where certain load or mounting conditions exist which make it desirable to modify the standard bearing. The basic tapered principle isn't changed; but changes are made in the angles of the cup, cone or rollers or possibly the bearing is made in 2-row or 4-row assemblies.



The bearings are made up of these four components

Single row type bearings are the kind most often used in wheels of mine cars and other mining equipment

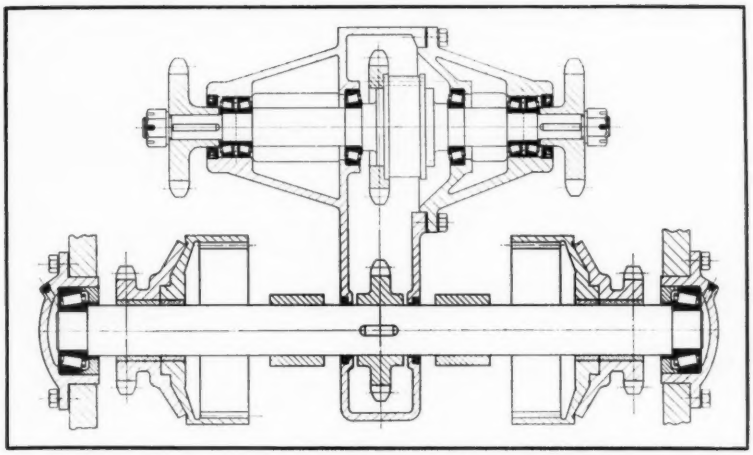
TS

Inspection Comes First

The first thing to consider in the maintenance of bearings on any type of equipment, is how often should the bearings be inspected. It usually is not necessary to remove wheels of mine cars or tear down machines for bearing inspection except when the unit is down for repair of some parts that might affect the bearings. If the bearings are lubricated with the proper type of lubricant and seals are in good condition, there should be no appreciable wear or cause for inspection except at normal overhaul periods for the machine. On automotive type equipment, such as trucks used for highway hauling where mileage piles up fairly rapidly, it is recommended that wheel bearings be removed, cleaned up, inspected and repacked with grease about every 30,000 miles. Seals usually wear some in that period and if the units run much longer than 30,000 miles, the lubricant gets badly contaminated with dirt and water and the life of the bearing is cut considerably.

Remove Bearings With Care

The first step when bearings are to be inspected is the removal. Bearing pullers are recommended so that bear-



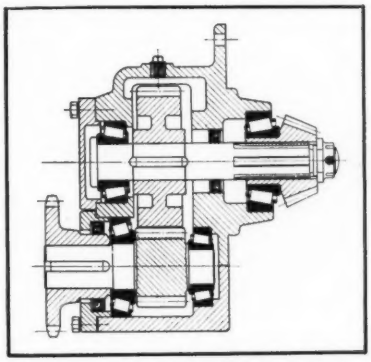
Typical sprocket drive for a coal loading machine. Bearing adjustments are described in the text

ings, shafts and housings are not damaged. Sometimes where larger bearings are on with tight fits hot oil can be used along with the puller. Hot oil applied to the bearing will cause quick expansion of the bearing and with pressure from the puller being applied the bearing will move before the heat gets through to the shaft.

There are cases where pullers or presses are not available for bearing removal. If a bar is used, it should be of unhardened mild steel. Hardened drifts, brass bars or center punches are not to be used. A hardened bar or center punch may damage the bearing and the brass bar will chip easily. These chips can get into the bearing to cause damage or may get behind the bearing face to prevent proper bearing seating. Great care must also be taken to hit only the bearing race and not the cage.

Clean and Protect

A bearing which has been removed from a machine should be first washed in clean kerosene or solvent, then dried with a compressed air gun. It is not wise to spin the dry bearing with the air gun as it may score due to lack of lubricant. The mechanic should also make sure there is no water in the air line whenever air is used to dry a bearing.



Bevel gear drive unit. Bearing adjustments are described in the text

If the cleaned bearing has been inspected and found to be satisfactory, is should be dipped in oil and wrapped in clean oil paper if not used immediately. There are only two parts in a Timken bearing which may have to be replaced. The cone which includes the cage and rollers is one, and the other is the cup. When making a bearing replacement, both parts should be examined and replaced if excessively worn or damaged. This is very important because a new cup installed over a badly worn cone will bring about an early failure of both parts. A new cone with a badly worn cup will bring the same result.

Watch Seals

When inspecting bearings, a point should be made to also inspect the seals. If they are worn or damaged they should be replaced. Worn seals allow dirt and water to enter the bearing housing. Proper maintenance of these seals is vital to the good performance of any bearing.

Store With Care

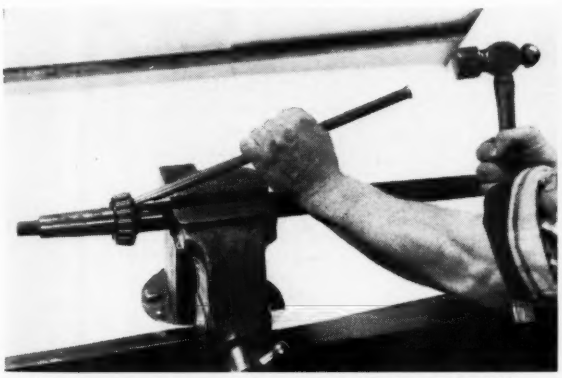
Bearings are packed in carboard cartons to give the bearing proper protection against dirt and moisture. Replacement bearings should be stored in a clean, dry place and should not be removed from the cartons until ready for use. There is no need to wash new bearings as the rust preventive will not harm the recommended lubricant.

After new bearings have been removed from the carton, they should be installed in the machine immediately or placed on a clean surface. They are not to be placed on the floor or a dirty workbench or left exposed in open trays, pans or cabinets where dirt, dust and moisture can reach them. Extra care at this time will be repaid with longer bearing life.

Inspection of Shafts and Housings

Before the bearings are reassembled, the shaft and housing need to be inspected and any nicks or burrs which may be found on the bearing cup or cone seats should be filed or scraped smooth.

Bearings should never be reassem-



If a bar or punch is used to remove a bearing, it should be made of unhardened mild steel. Bearing pullers are recommended for this job

Compressed air is good to use for drying a cleaned bearing but care should be taken not to spin the dry bearing with the air gun

bled in damaged or worn housings or on damaged or worn shafts. A worn bearing seat should be built up by metal spray or by applying a sleeve to the shaft with a heavy press fit. The shaft or sleeve should then be remachined to proper size, to assure a good fit.

It is also important that the shaft or housing is clean so that no dirt will get between the bearing and shoulder to prevent the bearing being properly seated.

Use Special Care in Assembling Bearings

In assembling bearings, the same care should be taken as in removal of bearings so no damage is done to the bearings or shafts or housings or other parts. Bearing drivers are available on the market. If bars are used, only mild steel should be employed as hardened steel drifts or chisel can easily cause damage to the bearings.

Adjustment of Bearings

Mine Car Wheels

To properly adjust the bearings, screw up nut, at the same time rotating the wheel in both directions until the wheel binds slightly, then unscrew nut, (one or two castellations) until wheel rotates freely without end play when the wheel is pulled to or from the mechanic. Then the nut is locked with a cotter pin and the hub cap put on.

How to Take Off Dust Collar

Build a narrow fire around the collar and axle, keeping the axle as cool as possible. A piece of pipe may be slipped over the axle to keep it cool. When the collar is cherry red, it may be removed by placing the axle on end, then by using the axle box as a driver, the dust collar can be removed. The axle should be placed on some wood surface to protect threads.

The same thing can also be accomplished by heating the axle with an acetylene torch.

To Replace Dust Collar

Heat the collar to a cherry red and slip it on the axle, making sure to get square backing against the axle shoulder. The assembly should then be allowed to cool without quenching.

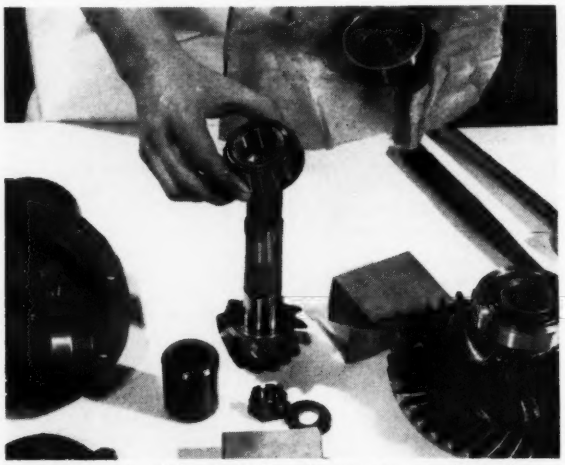
Mine Locomotive Journals

Bearings in each journal box are set up with a lateral play of 0.004 in. to 0.008 in. That is, if a bar is placed between the wheel and bearing box a movement of the box of 0.004 in. to 0.008 in. can be measured. A check of the bearing looseness should be made in this way approximately every 30 days. If the bearings show a lateral play in excess of 0.010 in., they should be readjusted. This should be done by removing a thickness of metal shim equal to the difference between the measured lateral play and the desired lateral play of 0.004 in. to 0.008 in. from under the flange on the cover plate.

In handling the shims, precautions should be taken to make sure that the shims are kept clean and that the proper thickness is put back in the journal box.

Mining Machine Transmissions

A typical sprocket drive for a coal loader is illustrated. The single-row bearings on the lower shaft are adjusted by means of shims between the cup carrier flange and the housing. This is also the case for the center bearings on the upper shaft. Outer bearings on the upper shaft are the 2-row NA type bearings, and are non-adjustable. All that is necessary is to clamp bearing through the cones onto the shaft. In this case the cups float in the housing.



Bearings should be treated as the precision machines they are. Special care should be taken to protect them by wrapping in clean oil paper if they are not to be used immediately

Heating of bearings for easier assembly is recommended for larger size bearings. It is important to see that the bearings are not heated over 275 to 300°F. Infra-red lamps are a simple method for heating bearings—a method that assures maximum cleanliness. If electric ovens or oil baths are used, the use of thremostatic controls is essential. But if an open flame is used to heat the oil, a bearing should not rest on the bottom of a pan as the heat will be transferred directly from flame to the bearings, causing possible damage.

Where cups are to be reassembled in hubs or housings with a heavy press fit, they can be shrunk in a deep freeze unit. An alcohol bath cooled with dry ice can also be used. And it may also be necessary to heat the housing, to get the cups to slip into place.

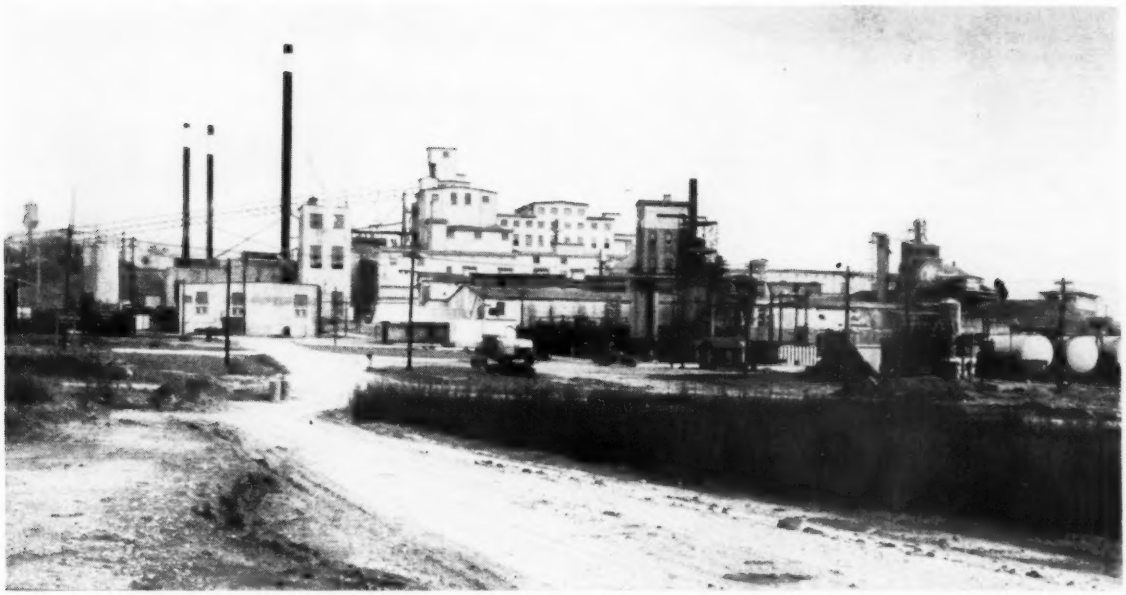
The single-row bearings on the illustrated bevel gear shaft are adjusted through the nut and gear hub. The sprocket bearings are adjusted by means of shims between end cap and housing.

The single-row bearings on the sprocket shaft in both examples are usually adjusted with free running clearance of about 0.002 in. to 0.005 in. end play. Bevel gear shaft bearings can be set with light preload of about 10 to 20 in. lb. of torque. The adjustment may vary in some cases from these general figures depending on design, lubrication and speeds. It is recommended that the adjustments specified by the builder for the particular job be closely followed particularly on transmission units.

Conveyor Assemblies

Adjustments on typical conveyor

(Continued on page 88)



About 800,000 tons of salt are produced annually in the Morton Salt Company's plant on Weeks Island, La.

Salt—A Basic Mineral

A Professional Writer's Description of the Two Principal Methods Used to Extract Salt in Louisiana.

By GUY BROWNING ARTHUR

SALT is one of our critically basic materials. It has a long history, and many highways began as trails to salt licks, for salt has always been indispensable to people on other than a meat or fish diet. It has figured largely in wars and conquests. Our Revolutionary War was grimly threatened by the loss of salt production on the Colonial side, for we had then developed only meager supplies in this country. The loss of salt mines in the South had much to do with the defeat of the Confederacy in the Civil War.

Today salt, with its 34 major chemical derivatives, supports our economy in an estimated 14,000 ways. Table salt takes only four percent of the output, and the market for the remainder spreads over 62 of the most important industries. The list becomes so long—from weed killers and textiles to metallurgy, paper, plastics, synthetic rubber and chemical processes—that it becomes fantastic.

The product has a low unit value, and can be produced with profit only from the purest or the most accessible bodies, using modern low-cost methods. In several ways the production of salt resembles operations in other materials. The two principle methods are mining and evaporation, and both are employed by the Morton Salt Co. in its nine plants. Mining methods are about the same in all underground workings. Especially fine cube particles are produced by evaporation. In some of the nine plants solar heat is used to evaporate salt beds at saline lakes.

About 800,000 tons are produced annually in the Morton plant on Weeks Island, La., operating on a salt dome of unusual size and shape. Most domes are mushroomed at the top, but this one is cone shaped, rounded over in a crown. It is 1½ miles in diameter below the crown, and the salt body has been proved down to 20,000 ft.

A dome is one of the phenomena of the intrusions and retreats of the ocean. No salt is found in rock formations. Ancient oceans, trapped by upheavals of the earth's surface, have evaporated, leaving solid bodies of salt. The accepted theory of the formation of a dome is that the weight of soil and vegetable debris around an area forced the salt body upward. Weeks Island is higher than the surrounding terrain, which seems to support the theory of formation.

Mining

At present the underground operation is at the 735-ft level. The main building is built around the shaft, which is much like those at coal mines. Vertical timbers form the guides for the bucket, and slanting timbers brace the tower. The roof of the building is carried up around the shaft to house it in completely.

About the Author

Guy Browning Arthur took correspondence courses in mechanical engineering while serving a four-year apprenticeship in fine tool making. Later he broadened his scope by studying civil engineering.

Arthur's varied experience includes nine years in Pittsburgh with Jones & Laughlin Steel Co. on mill design and with Heyl & Patterson on the design of complete coal and ore handling plants at mine headshafts. He has also been employed by the Portland Cement Association, Construction Machinery Corp., National Lime Association, and the U. S. Government in the Department of Interior and the War Production Board. Arthur took extension courses in writing and shifted gradually into publicity and promotion. He is now retired and does free lance writing.

In the present shaft there is only one skip—five ft square and 10 ft deep, holding 6½ tons. There is a steel ladder in one corner, on which the 35 below-ground workmen climb in and out, morning and evening.

The shaft is driven through 88 ft of unconsolidated overburden, the saturated soil and water typical of this low country, and then through the dome. Salt has the peculiar characteristic of protecting its main body by forming a shell of crystallized brine over its exterior surface. There is no seepage of water into the mine.

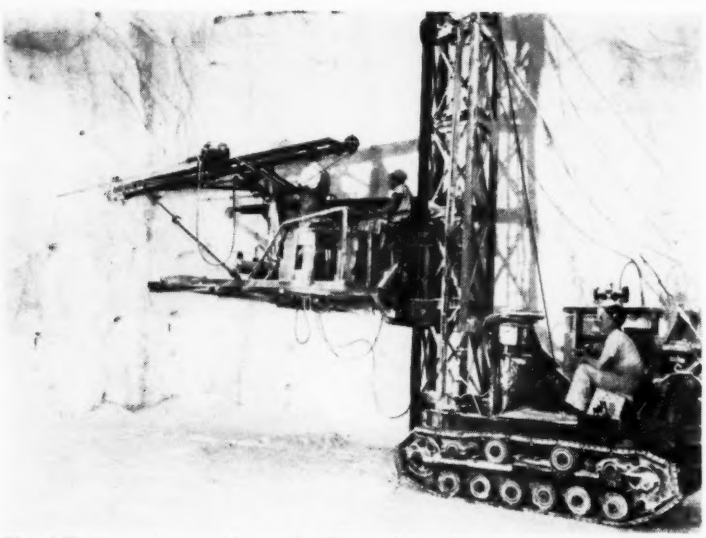
Inside, the contrast with other mines is striking. In all other mines the product is more or less incidental to some other material. It occurs in a vein, or is embedded in a matrix. When it is taken out, the predominate material must be left supported. When a vein has a high enough face to permit of low-cost cutting, the problem of roof supports is all the more critical.

But in a salt dome there is no other material. Everything is pure salt—walls, floor and ceiling. The solid mass of tiny salt crystals throws light rays back and forth, so that photography with flash bulbs is difficult. The machines stir up salt dust, which covers shoes and clothing. Pictures can be taken only when the machines are stopped.

The mining technique is similar to that of coal. The tunneling is projected in high, wide, corridors, leaving separator walls for support. Even with all the production in this mine, over many years, the need for a supporting system similar to that in coal mines has not yet developed. The accumulated experience of mining other materials will have to be called into play at any time when the operation expands, especially if a lower level is ever opened below this one.

The skip bucket runs between timber guides, into which the brakes are set automatically in case of emergency. The bucket automatically picks up its load at the bottom and unloads at the top. (Note the salt dust that has accumulated on timbers and equipment)

A standard undercutting machine, especially adapted to salt, cuts back 10 ft under the wall



The drill rig most commonly used. The working platform moves up and down on the tower, and the drill unit moves back and forth on the extended track

Corridors are 60 ft or more wide and about 40 ft high. Compared with other mines this is a most extraordinary condition. Any main corridor can be extended for over a mile, total, and cross tunnels can be projected from this one to any reasonable limit inside the exterior of the dome. Consequently the problem of a roof support system is not pressing.

A new shaft is being sunk about 1000 ft from this one. It will go down 900 ft, and will have many modern features. There will be two buckets, balanced in transit, with a man cage besides. The drilling and excavating is protected by freezing the surrounding soil and water, and this refrigeration will be maintained until the new shaft is fully enclosed.

Face Preparation

Cutting, shooting down, and loading are somewhat like that in coal mining, except that the the entire face of the wall is the yield. A standard undercutting machine works on the floor, cutting back 10 ft under the wall, with cutters adapted to this material.

But the drilling machine is a special rig designed for this job. The design varies in the several Morton mines. Here at Weeks Island the rig is mounted on caterpillar tracks with a long boom hinged on the front end. This boom carries a platform about 10 ft long—crosswise of the boom—and four ft wide. On this platform four drill units are mounted, each with its own motor. The platform remains level, no matter how the

boom is elevated.

The machine in the illustration is in more general use. The working platform moves up and down on the tower, and has only one drill unit. The drill unit, with its motor, moves back and forth on the extended track. Drills, 1¼ or 1⅜ in., bore 10 ft into the wall. The weight of the work platform is balanced by the motors and winches on the main body.

Where this rig is used, another machine, similar to the drill rig at Weeks Island, takes care of the loading. From the wide platform several holes can be loaded at one setting. Low-potential dynamite is used. The entire wall is shot down at once, loosening about 1000 tons of salt. In this mass any residue of powder is lost, and there is no traceable contamination of the product.

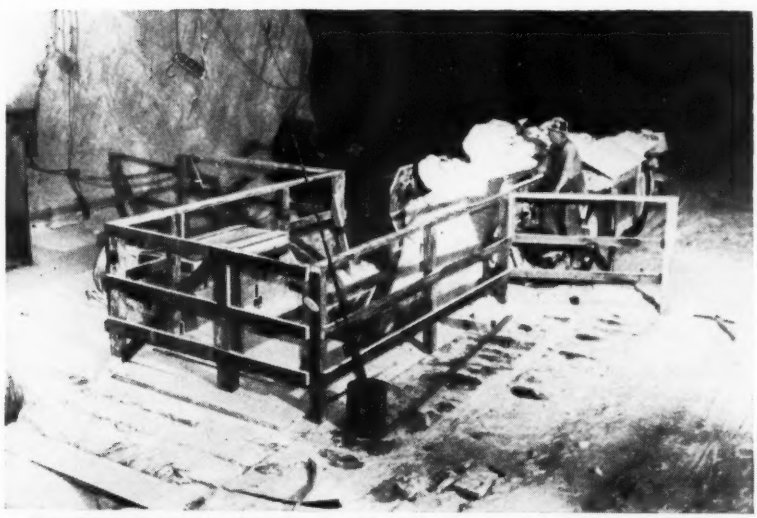
Loading and Transporting

Into this mass a Joy loader moves under its own power. The front is a wide pan which is thrust into the pile. Arms mounted on the sides sweep salt from the sides in a circle quadrant, into the middle of the pan to feed a short conveyor which carries it up through the loader to the back.

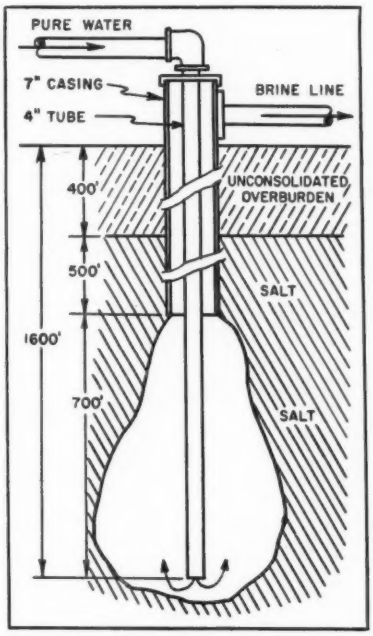
It discharges onto the conveyor which runs over the top of the transfer truck, and distributes it evenly along the length of the body. The transfer trucks are about 14 ft long and four ft high. As soon as one truck is filled another moves into position, against the loader.

These trucks move at a slow pace, but the operation as a whole is very fast. They carry to a below-floor-level hopper, at the bottom of which is a revolving grinder which breaks up lumps and cakes. The discharge from this grinder is into a capacious chute. When the bucket is spotted at the door, the chute load is shot into it in a flash. The bucket rises as soon as it is filled, a matter of seconds, and dumps its load at the floor level above, descending immediately for another filling.

A shuttle car ready for loading by a mechanical loading machine



Transfer truck dumping into hopper. The salt goes through a revolving grinder to break up lumps and cakes, and then into a chute to wait for the skip



Scheme of salt well

Evaporating

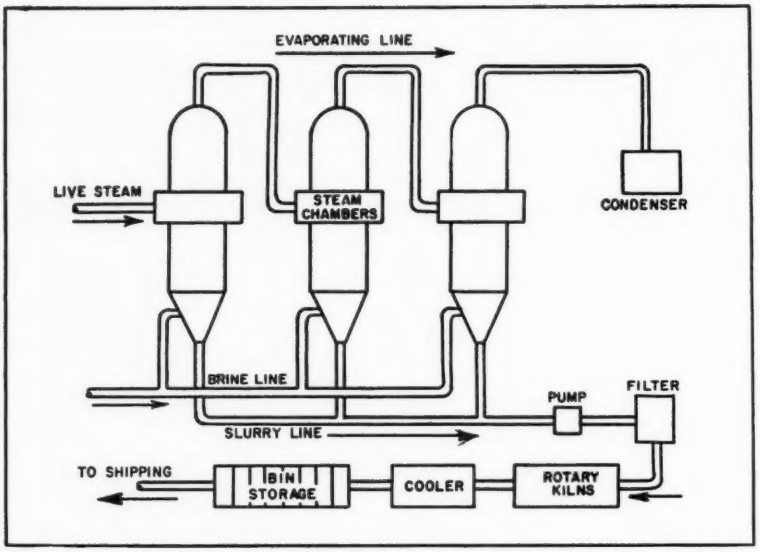
While this is not mining, it is another way of getting salt to the surface. The system is similar to that used for sulphur, but pure water is used here for dissolving salt, instead of the steam required for sulphur.

A seven-in. casing is driven through 400 ft of unconsolidated overburden and 500 ft of salt, to a depth of 900 ft. Inside this casing a four-in. tube is set to reach a total depth of 1600 ft. This exposes 700 vertical ft of salt to extraction by water, from the bottom of the four-in. tube up to the seven-in. casing.

Pure water is pumped from the adjoining chemical plant at 275 lb pressure. It goes down the four-in. tubing, dissolves salt from the walls of the enlarging cavern until it is a brine with about 25 percent salt content, and flows out of the seven-in. casing at the top into a line which carries it to the evaporators.

The evaporating system is the same in all Morton plants. It is designed to produce the optimum in salt, cube particles. This is contrasted with flake salt, which is made for such products as pretzels. The evaporators are three-story vessels with domed tops and cone-shaped delivery bottoms. Around the middle of each one is a wide belt or steam chamber. These vessels are similar to "sugar pans," and are run in series.

Brine is pumped in at the bottom, and circulated through tubes in the steam belt. Vapor rising off the boiling brine goes out at the top of the first evaporator and into the steam belt of the second; vapor from that



Evaporating flow line

effect into the steam chamber of the third; and vapor from that one to the condenser.

Salt drops to the bottom of the evaporators, and is pumped through a slurry line to a filter which sucks out most of the remaining moisture. The damp salt then enters rotary kilns which bake it dry at white-hot temperatures. From here it is cooled and screened into specific grades. In this industry a "grade" is a size. All the product is of uniform quality.

Flake salt is made by evaporating in 100-ft long pans, called grainers. The lower the temperature of the brine, and the longer it takes to evaporate, the larger are the flakes. It is in steady demand for pretzels and crackers, butter and cheese, and for many other products.

Marketing

In most mining the production and marketing are widely separated in departments. Salt is so pure that it goes from mine head and evaporators directly to market in packages and bulk. All of it is stored in bins for different grades. There are four grades of coarse salt and three of finer particles. Any of it may be drawn out for various purposes, and all may be subject to blending and compounding.

Finer grades go to make such drugs as insulin. Special products may be made from either fine or coarse crystals. Additives, such as potassium iodide, are compounded to reach special markets. Sulphur, phospates, potassium iodide, and other ingredients go into salt for stock foods.

For water softening, beer, liquor, laundries, dyeing, tanning, and other industries salt is packed in multiwall bags up to 200 lb in size, on standard bagging machines.

There are five and 10-lb "pockets" which are packed in 60-lb bags. A rectangular 1½-lb box and the common round household box are filled on standard machines.

A considerable part of the output goes into box cars and hopper cars to packing houses, bakeries, flour mills making prepared mixes, cheese factories and creameries.

Some goes by barge, out of the little bay at the rear of the plant into the Intracoastal Waterway to ports on all navigable streams, as far as Pittsburgh, Chicago and Kansas City.

There are many markets besides those mentioned; too many to be mentioned in connection with mining or production. The tremendous spread of salt into these markets is possible only because it is produced at low cost from deposits which lend themselves to fast and economical operation. Expensive treating or processing between getting the salt out, and getting it to the shipping department, would immediately cut the market back to a small part of its present scope. A high-cost plant has no chance in competition. But as it is, salt is indispensable in our economy.

Detergents for Mine Fires

(Continued from page 61)

men who are submerged in the foam can breathe reasonably freely. (The staff themselves usually wear masks because after long periods in the foam, their eyes become sore.)

At another demonstration a fire consisting of stacks of timber weighing 750 lbs and strips of rubber conveyor belt weighing 150 lbs was allowed to get burning well and to blaze away for ten minutes before the foam was released. In a minute or two the foam traveled from the net, 90 yards away, and suppressed the fire, except for some smoldering which could be dealt with by workers moving into the fire zone.

Once flaming combustion has ceased, the foam passes through the fire zone and cools the area. The texture is quite unlike that of normal fire-fighting foams, which generally have a much lower expansion ratio (10:1 compared with 1000:1 measured in the experiments), and the mean bubble diameter is about 0.25-0.5 in.

Mine Tests

The present experiments aim at ensuring that the wettest foam is carried the greatest distance with the least water gauge. The foam is formed at the net so long as the spraying continues, but as the foam plug lengthens, the mass of bubbles is slowed down by the drag of the foam on the side of the roadway. It comes to a halt when the drag equals the motive force available—the product of the water gauge across the foam plug and its cross-sectional area. Plugs up to 200 yards long have been produced at Buxton with a water gauge of 0.4 in.

Some mining engineers thought that in the rougher and dirtier conditions of a working mine, the foam would be stopped more quickly. The researchers therefore gave the foam a thorough test over two days at a pit about 1000 ft below ground in County Durham. They found that foam plugs of sufficient moisture content and well over 200 yards long could be generated "comparatively easily" and that the roughness and extreme dryness of the conditions had little discernible effect. It was appreciated, however, that for truly long range work—the aim is to be able to deal with a fire at least 1000 ft away—a much tougher foam which would not drain away so quickly had to be discovered.

The researchers have had good results with practically any ordinary kitchen detergent, but they are now experimenting with "more esoteric recipes" in the hope fresh mixtures will do the trick. The search is on now for the most suitable net, wetting agent and foam stabilizer, but many smaller problems remain to be solved before the experiments end.

See MANUFACTURERS FORUM Beginning on Page 89

An Unusual Roof Bolt

This New Swedish Technique of Roof Bolting Has Only Recently Been Introduced into the United States. The Method Can Supply: Spread Anchorage for Weak Ground, Corrosion and Air Scaling Protection, and High Holding and Shear Strengths

By R. B. CHOUTE
Perfo Div.,
Sika Chemical Corp.

SWEDISH ideas in the mining field have gained a great deal of acceptance in the United States in recent years. The vast amount of underground construction going on in that European country seems to encourage new, simple improvements in mining practices.

One of the newer ideas recently imported into this country is a by-product of the tremendous Swedish program to get important permanent plants underground. It is a roof bolt for areas with poor anchorage, active corrosion, or weaknesses in shear strength. This method of bolting attempts to provide unconcentrated even anchorage, with anti-corrosion mortar encasement, and dry pack solidity resistant to shear.

Bolting Procedure

A pair of half cylindrical sheet metal tubes with perforated walls equal in length to the drilled bolt hole are utilized. The diameter of the tube is less than that of the drilled hole yet slightly larger than the size of the bolt to be placed. A firm sand and cement mortar mix (with or without accelerators or expandifiers) is first trowelled into the semi-cylindrical tube halves. Once filled flush, the two halves are coupled and fastened together to make a perforated sheet metal tube full of damp mortar. The filled tube is inserted into the drilled hole. The bolt to be used is then hammered into the tube hole, thereby extruding mortar out evenly along the length of the perforated tube as the bar progresses into it. The relative volumes of the bolt, tube (called Perfo), and hole are correlated to insure that an excess of mortar will more than fill the voids. Sledgehammers won't work: the vibration of a chipping or electrical hammer apparently does the trick. The bolt may be threaded, smooth, or even deformed. The Swedes often use an ordinary reinforcing bar, with or without an anchor plate. After the bolt is fully seated, the result is a completely filled drill hole reinforced with stressed or unstressed steel. The mortar shell completely encases the unit, transferring the anchorage load uniformly throughout the entire length, while at the same time acting as a sizable shear pin to resist lateral movement of rock stratas.

Such a mortar encased unit is not a cure-all. There are still many areas where timbers and ribbing are needed. Costs probably will slightly exceed that of ungrouted or unmortared bolts. Instantaneous holding power can only be achieved by incorporating Perfo with the wedge type anchor or by excessive use of mortar setting accelerators. But if the Perfo Metallic Tube Method can enable another 10 percent of the U. S. mines to enjoy the benefits and savings of roof bolting, it will be welcomed.

Advantages

On the assets side, the features are interesting. Permanency of the installation is virtually guaranteed by mortar protection against air scaling, corrosion and erosion. The uniformly distributed anchorage means more gross load can be applied to weak ground or to incalculable ground with lower stresses. Thus in soft sandstone or shale, sufficient anchorage might be attained to warrant roof bolting. Not only does the mortar fill and seal the hole to prevent its acting as a collecting channel for ground waters, but the long bar encasement assures very high tensile and shear strengths. In good rock, with plain unaccelerated mortar, a six-ft long, one-in. round deformed reinforcing bar can hold 27 tons after 24 hours. In four days this unit can hold the bar strength—34 tons. With accelerators, the U. S. distributors of Perfo, the Sika Chemical Corp., of Passaic, N. J. feel safe in assuring as high as 15-ton strength in six hours, or under emergency conditions, 10 tons in two hours. Bolt length and shape and mortar mix should be varied to provide the best results for a given rock condition. The shear strength of the unit is obvious. How many roofs today could be strengthened by preventing any lateral movement whatsoever between successive rock strata? Side slippage, sloughing, earth bulging, and rock popping can all be reduced by the installation of a unit high in shear strength and what unit can have higher strength than a steel bar encased in a high pressure dry pack?

It might be added that in Sweden short Perfo units are apparently being greatly used as tie anchors or dowel seats to tie concrete to rock, concrete to concrete, or steel to either.

To summarize then, The Perfo unit probably cannot:

- Compete pricewise with ungrouted bolts.
- Cure problems where the upper stratas have no holding power.

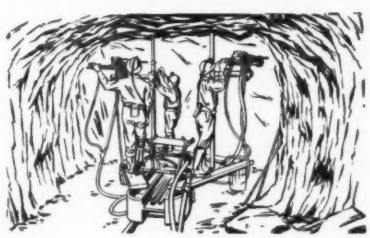
The Perfo can supply:

- Spread anchorage for weak ground.
- Corrosion protection.
- High holding strengths.
- High shear strengths.
- A permanent unit.

Three U. S. Mines Interested

Where has the Perfo been really tested? Most of its usage has been in Sweden. A good typical example would be the Kilforsen and Stornorrfors hydro-electric plants where these units were used to obtain permanent roof support. The machine hall in the former plant (a room 60 by 315 ft) used a great number of Perfo tubes. Among projects outside of Sweden are the tunnels in Egypt's mammoth Asswan Dam project.

Three mines in the United States are currently making first run tryouts on the technique of installing Perfo bolts. The Bureau of Mines has indicated interest in these units. Formal approval has not yet been sought. Canadian mines are making way for the introduction of this new bolt in some of their most troublesome areas. The typical Perfo tube and roof bolt assembly is only warranted where other bolts cannot meet the challenge of permanence or strength. But in those areas where it is warranted, a good look should be taken at this new Swedish technique.



Specifications for Roof Bolting Materials

The Committee on Roof Action Has Accepted the Following Specifications Which Are Submitted Here to the Industry as Mining Standards

Submitted by G. P. MAHOOD, J. B. DEMPSEY, A. K. ROBERTSON, J. H. SANFORD and E. M. THOMAS

IN THE PAST, several manufacturers have made roof bolts from steel bars which were made in accordance with chemical requirements, whereas the specification now advanced provides that the steel bars from which the roof bolts are made shall be made in accordance with certain physical requirements contained in Specification ASTM A-306, latest issue. For instance, regular-strength headed or slotted bolts formerly made of AISI Specification C-1020 up to C-1026 steels will be made from bars of steel having a minimum tensile strength of 60,000 psi and high-strength bolts formerly made of AISI Spec. C-1038 to C-1045 steels will be made of grades of steel having a minimum tensile strength of 80,000 psi. No maximum tensile strengths are specified since the minimum elongation requirements will automatically prevent the use of steels which are too brittle for roof bolt manufacture.

Purpose of Recommendations

(1) *Safety:* To protect the consumer by assuring that roof bolting materials shall be made in accordance with certain specifications pertaining to quality and minimum dimensions. It must be remembered that the lives of mine workers are dependent upon an effective roof structure provided by roof bolting. In all safe structural designs it is common practice to avoid loading materials beyond their elastic limits. This should be considered an inherent practice in roof bolting. Over-loading during installation should not be allowed. Therefore, these specifications, which require minimum tensile properties for the bars from which roof bolts are made, are very necessary. The minimum yield loads shown on the accompanying drawings for each bolt are particularly significant as far as practical applications are concerned.

(2) *Interchangeability:* To establish certain manufacturing practices to provide a uniformity of product without suppressing improvements in design and advancements in engineering.

Specifications for Roof Bolts

Steel Specification: All mine roof bolts shall be made of open-hearth or electric furnace steels according to Tentative Specification for Carbon-Steel Bars subject to Mechanical Property Requirements ASTM Designation: A-306, latest issue.

Bars from which roof bolts are made shall have the following tensile properties, shown in Table I.

Bolt Dimensions: In Figure 1 is shown essential, basic and minimum dimensions of ⅝-in. and ¾-in. square-head roof bolts and one-in. slotted roof bolts. They are not intended to preclude the use of special reinforced, recessed or self-centering heads if the consumer so desires.

Thread Fits: All threads shall accept a Class 2 "go" ring gage.

Bolt Head Markings:

(1) The length in inches shall be marked on each bolt head. For example, the figure 60 shall indicate a five-ft bolt.

(2) All ⅝-in. high-strength bolts shall be marked with a five-point star of approximately ¼-in. in size. All ¾-in. high-strength bolts shall be marked with a triangle of approximately ¼-in. size.

(3) Each bolt head shall be marked to identify the manufacturer.

Expansion Shells

Material for expansion shells and plugs shall conform to the requirements of ASTM Specification for Malleable Iron Castings A-47 latest issue, Grade 32510, or shall be forged steel with a maximum sulphur content of 0.23 percent.

Wedges for Slotted Bolts

Wedges may be made of steel or cast malleable iron in accordance with the following:

Steel Specification: Same as for

TABLE I	*Tensile Strength psi*	*Yield Point psi*	*Elongation, min. in 8-in. gage length*
Regular-Strength Headed or Slotted Bolts ..	60,000 min.	30,000 min.	17 percent
High-Strength Bolts	80,000 min.	40,000 min.	12 percent

regular-strength roof bolts, namely; open-hearth or electric furnace steels in accordance with ASTM Designation A-306, latest issue.

Cast Malleable Iron: Material for malleable iron wedges shall conform to the requirements of ASTM Specification for Malleable Iron Castings A-47, latest issue, Grade 32510.

Basic Dimensions:

Length:	5½ in. minimum, 6 in. maximum
Width:	¾ in.
Thickness:	¾ in. or ⅞ in. or 1 in. Tapered to chisel point of 1/16 in. maximum thickness.

Mine Roof Plates

Steel Specification: Any open-hearth or electric furnace steels suitable for punching and shearing may be used. If Bessemer steels are used the carbon content shall be 0.15 percent maximum and the manganese content shall be 1.00 percent maximum.

Thickness: Optional, except that plates under 5/16 in. bearing directly against the mine roof shall be embossed.

Angle Washers, Ties & Channels

Steel Specification: These products shall be made of open-hearth or electric furnace steels, in which the following shall not be exceeded:

Carbon	0.40 percent
Phosphorus	0.04 percent
Sulphur	0.05 percent

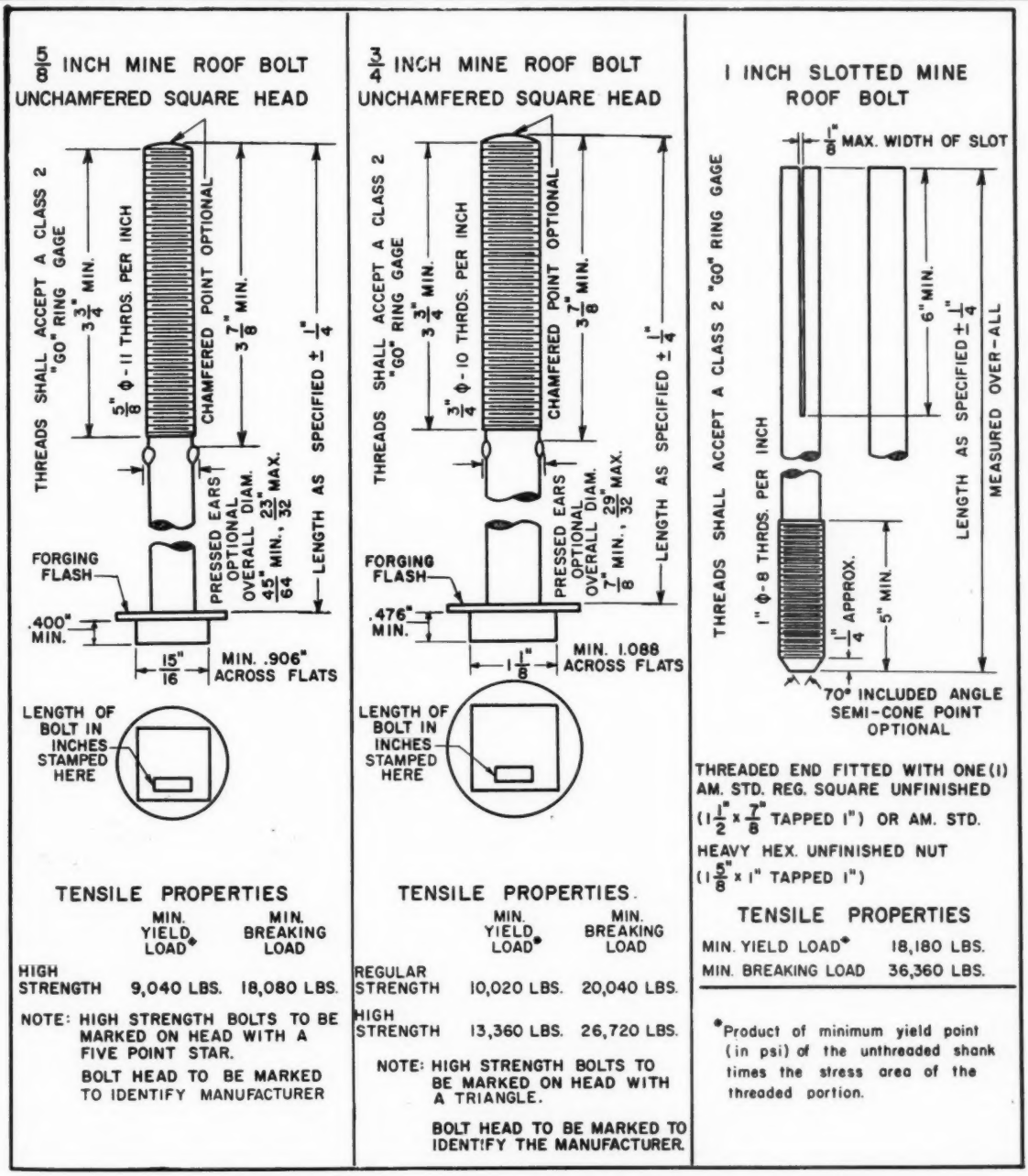

5/8 INCH MINE ROOF BOLT
UNCHAMFERED SQUARE HEAD
THREADS SHALL ACCEPT A CLASS 2 "GO" RING GAGE
3 3/4" MIN.
5" 5/8
11 THRDS. PER INCH
CHAMFERED POINT OPTIONAL
3 7/8" MIN.
LENGTH AS SPECIFIED ± 1/4"
PRESSED EARS OPTIONAL
OVERALL DIAM. 45/64" MIN., 23/32" MAX.
FORGING FLASH
.400" MIN.
15/16"
MIN. .906" ACROSS FLATS
LENGTH OF BOLT IN INCHES STAMPED HERE
TENSILE PROPERTIES
MIN. YIELD LOAD*
MIN. BREAKING LOAD
HIGH STRENGTH 9,040 LBS. 18,080 LBS.
NOTE: HIGH STRENGTH BOLTS TO BE MARKED ON HEAD WITH A FIVE POINT STAR.
BOLT HEAD TO BE MARKED TO IDENTIFY MANUFACTURER
3/4 INCH MINE ROOF BOLT
UNCHAMFERED SQUARE HEAD
THREADS SHALL ACCEPT A CLASS 2 "GO" RING GAGE
3 3/4" MIN.
3/4" 10 THRDS. PER INCH
CHAMFERED POINT OPTIONAL
3 7/8" MIN.
LENGTH AS SPECIFIED ± 1/4"
PRESSED EARS OPTIONAL
OVERALL DIAM. 7/8" MIN., 29/32" MAX.
FORGING FLASH
.476" MIN.
1 1/8"
MIN. 1.088 ACROSS FLATS
LENGTH OF BOLT IN INCHES STAMPED HERE
TENSILE PROPERTIES
MIN. YIELD LOAD*
MIN. BREAKING LOAD
REGULAR STRENGTH 10,020 LBS. 20,040 LBS.
HIGH STRENGTH 13,360 LBS. 26,720 LBS.
NOTE: HIGH STRENGTH BOLTS TO BE MARKED ON HEAD WITH A TRIANGLE.
BOLT HEAD TO BE MARKED TO IDENTIFY THE MANUFACTURER.
1 INCH SLOTTED MINE ROOF BOLT
1/8" MAX. WIDTH OF SLOT
THREADS SHALL ACCEPT A CLASS 2 "GO" RING GAGE
1" 8 THRDS. PER INCH
1 1/4" APPROX.
5" MIN.
6" MIN.
LENGTH AS SPECIFIED ± 1/4"
MEASURED OVER-ALL
70° INCLUDED ANGLE SEMI-CONE POINT OPTIONAL
THREADED END FITTED WITH ONE (1) AM. STD. REG. SQUARE UNFINISHED (1 1/2" x 7/8" TAPPED 1") OR AM. STD. HEAVY HEX. UNFINISHED NUT (1 5/8" x 1" TAPPED 1")
TENSILE PROPERTIES
MIN. YIELD LOAD* 18,180 LBS.
MIN. BREAKING LOAD 36,360 LBS.
*Product of minimum yield point (in psi) of the unthreaded shank times the stress area of the threaded portion.

Fig. 1—Basic dimensions for ⅝-in. and ¾-in. square-headed roof bolts and one-in. slotted bolts

Trackless Mining at Trona

(Continued from page 38)

pansion, is now under construction.

Shafts No. 1 and No. 2 are in the immediate area of the surface operations while No. 3 is located approximately 1¼ miles south of the plant site.

Now serving as the intake air course, No. 1 shaft contains equipment for lowering men and materials. It is 12 ft in diameter, concrete lined, and goes down approximately 1600 ft. No. 2 is 14 ft in diameter, concrete lined, and serves as the production shaft and as exit air course.

No. 3 shaft will be concrete lined, 18 ft in diameter. It will be downcast, providing air for the entire mine operation. No. 2 will continue to serve as the production and exit air shaft. A fresh air split will be carried to No. 1 so as to permit its use for transporting men and materials from the surface.

Shaft No. 1 has a single-drum hoist with attending appurtenances for the handling of men and materials.

The production shaft, No. 2, is equipped with an automatic skip hoist to carry the ore to the surface. The hoist is of the double-drum, balanced type driven by a 500 hp dc motor, powered by a synchronous motor-driven MG set. While the hoist is completely automatic, it can be operated manually from a desk-type console. The seven-ton-capacity skips give the hoist a normal capacity of 200 tons per hour. Loading of the skips is accomplished automatically from an 800-ton intermediate underground storage bin.

Although the No. 3 shaft will be equipped with minimum hoisting facilities for shaft servicing purposes, provisions were made in the initial construction to allow conversion to full scale hoisting facilities at some future date as the need develops.

Mine Research Crew

The experience in operation of the trona mine on a high-level-production basis dates back only about three years. A very active and progressive management and mine staff have dedicated themselves to continuous efforts towards new methods and improvements to the existing facilities. A mine research crew, composed of mining engineers, is attached to the mine staff, with an ever-increasing agenda of projects. Projects include continuous study of adjacent rock formation and effect on ground conditions, time studies, ventilation, and new equipment. The use of such a technical service department in mining is justified by the improved efficiencies, ore costs, and general safety of the operation.

Occurrence and Exploration

(Continued from page 59)

the problem of finding those large, deeply buried uranium ore bodies which geological logic dictates must be present. It is not intended as a technique for the lone prospector although certain aspects may be equally helpful to the individual as well as to a large company exploration department.

(a) Look for areas which are favorably situated with regard to regional and local structure and particularly at or near the intersection of the lineation patterns previously described.

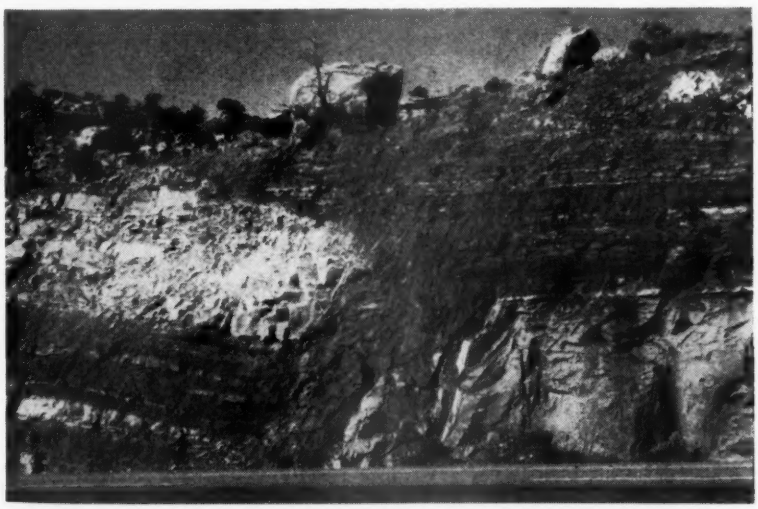
(b) Make detailed magnetic, gravity, and radiometric measurement on a regional basis with sufficiently close control to delineate small local deviations from the norm which might be correlative with known ore-producing districts or which define in more detail the pattern of cross lineations referred to above.

(c) In the vicinity of any critical area, as indicated by the above observations, study the terrain geochemically for comparison with normal terrain. The object of this is to localize zones which may have served as conduits for mineral-bearing solutions. The implication is that if ore were deposited, it should be somewhere along the path taken by the mineral-bearing solutions. These zones might be recognizable visually because of color changes, leaching, mineral modifications or additions, or by analysis of the rocks for the presence or absence of critical elements or an abnormal ratio of two or more constituents.

Solutions invading the country rock may alter its composition (1) by introducing trace quantities of elements not indigenous to the formation, (2) by leaching away part or all of certain elements normally present, or (3) by effecting alteration of or reaction between constituents already present so as to form new minerals. (Oxidation-reduction reactions or the formation of clay from feldspar would be examples of this.)

Future Investigations

Finding the multi-million ton, high-grade uranium ore bodies of the future will require looking for the combinations of geological circumstances which are favorable to the deposition of ore in the rocks which do not outcrop as well as those exposed at the surface. Since any prudent exploration program must cost less than the value of the minerals found thereby, it is necessary to utilize a combination of observational and geological evidence to localize potential habitats for uranium worthy of detailed and more expensive geophysical and geochemical investigations which, in turn, should "pinpoint" spots of sufficient promise to warrant drilling a still more expensive deep hole to test the possibility. In other words, the philosophical approach would be to use the drill to determine how good an ore body had been found rather than to prospect for ore. The success of such a program will naturally vary in the hands of different operators because of the large subjective influence imposed by the imagination and intuitive perception of the geologist in charge.



Faulting may provide preferential zones of high permeability for uranium bearing solutions to invade country rock

Wheels of GOVERNMENT

AMC

As Viewed by HARRY L. MOFFETT of the American Mining Congress

CONGRESS is in the home stretch and is gearing its activities to a projected target date of July 14 for adjournment. As in the past, however, the end could come much later if consideration of major legislation is prolonged.

Key to adjournment in most previous Congresses has been approval of the last appropriation measure. All money bills are expected to be sent to the White House by July 1 except funds for foreign aid. Debate on foreign aid will probably be heated with a rising feeling in Congress that the amount to be spent in this field should be slashed considerably.

Aside from the funds bills, several other controversial matters remain to be settled. These include social security coverage, the highway program, outlays for defense, a revised housing program, and authorization for Hell's Canyon high level dam. The last-named will split Congress into two camps—those that favor private development of power projects and those who seek further Federal control in this field.

The President has signed the revised farm measure and thus has placed on the statute books a provision guaranteeing that minerals and metals received in exchange for surplus agricultural products will be locked up in a supplemental stockpile subject to disposition on the same terms as materials acquired for the national stockpile.

At this writing the outlook for Congressional authorization of the Organization for Trade Cooperation (OTC) is very dim, with most observers predicting that it is a "dead duck" for this session.

Revision of the Taft-Hartley Act is also out the window for this Congress. The House Labor Committee has refused to take up any of the pending bills which would amend that act.

Another measure which has been placed in the legislative deep freeze is the recurrent proposal to repeal the law under which the government acquires newly mined domestic silver at a seigniorage charge of 30 percent of the $1.29 coinage price. A Senate Banking subcommittee refused to report this measure to the full committee by a 6-to-1 vote.

New Pollution Measure

A revised Water Pollution Control Act has been approved by Congress and is on the President's desk. As finally adopted, the bill authorizes Federal grants for construction of state or municipal water pollution treatment works, a provision inserted by the House. It also authorizes an annual appropriation of $3 million for the next five years for grants to state water pollution agencies, and an annual appropriation of $50 million for the next ten years for construction grants.

When the measure was approved by the House, it provided for 33⅓ percent federal participation in construction of pollution treatment facilities but a House-Senate conference committee limited this participation to 30 percent and placed a ceiling of $250,000 on each such grant.

Oil Imports Under Fire

Excessive imports of oil came under heavy fire both from Administration officials and from members of Congress during the past few weeks.

Undersecretary of State Herbert Hoover, Jr., speaking before the Interstate Oil Compact Commission, declared that some segments of the oil industry are failing to cooperate with the Administration in its attempt to solve the import situation without federal controls and warned that such controls may be imposed if the oil companies continue to bring in excess oil from abroad.

Two Congressmen from oil producing states took the House floor to criticize ODM Director Arthur Flemming for lack of positive action to restrict oil imports. Representatives Jarman (Dem., Okla.) and Ikard (Dem., Tex.) charged that Flemming's pleas to oil importers to comply voluntarily with recommendations of the Cabinet Energy Resources Committee by limiting oil imports to the same basis as in 1954 have been ignored. They said that 1956 oil imports exceed the 1954 ratio of imports to domestic production by 300,000 barrels daily. Ikard charged Flemming with exempting more than 75 per cent of total imports from compliance with the 1954 ratio, since imports from Canada, Venezuela, through the West Coast, and residual oil for ship fuel were excluded from his import limitation directive.

Meanwhile, the Office of Defense Mobilization has reconstituted the four-man task force that prepared recommendations on oil imports for the Cabinet Committee on Energy Resources and directed it to reevaluate the import situation.

Gatt Tariff Cuts Announced

The State Department has announced the tariff cuts granted to "free world" countries under the General Agreement on Tariffs and Trade (GATT). The new duties became effective June 30 and will be applied to imports valued at $911 million annually.

The U. S. concessions to foreign nations amounted to a 15 percent re-

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WATER POLLUTION: New Act in offing
OIL IMPORTS: Under fire
GATT: Tariff cuts announced
COAL RESEARCH: Hearings held
MINERALS BILL: Approved by Senate
HIGHWAY PROGRAM: In conference
RENEGOTIATION ACT: Being revised
INTERNATIONAL MATERIALS RESERVE: Unlikely
"PRE-MERGER NOTIFICATION": Under study
URANIUM PROGRAM: Extended through 1966

duction in present tariff rates, and will become effective at the rate of 5 percent a year as provided for in the 1955 Trade Agreements Act. Reductions in rates were made on such items as aluminum, copper, magnesium, molybdenum ore and concentrates, manganese alloys, chromium and chrome alloys, iron and steel bars, steel ingots, blooms and slabs, and non-agricultural machinery. The reduction of 15 per cent in the import tax on copper would apply only when the presently suspended 2 cents per pound import tax is re-imposed but would not operate if the price of copper fell below 24 cents per pound.

Concessions granted to the United States by other countries included reductions in duties on heavy machinery, motor vehicles, airplanes, electrical equipment, and petroleum products.

Coal Research Hearings Held

A special subcommittee of the House Interior Committee, headed by Rep. Edmondson (Dem., Okla.), began hearings early in June on a resolution by Rep. Saylor (Rep., Pa.) calling for an inquiry into research programs which might bring about new and expanded uses for coal.

Assistant Secretary of the Interior Felix Wormser endorsed the study. He told the committee that large future increases in total energy requirements can be met by expansion in the use of coal, but that new approaches must be applied to all phases of coal technology if the demand is to be met. Other Interior Department spokesmen predicted that developments in mining methods and technology will substantially raise the present recoverable coal reserve estimate of 950 billion tons.

Harry LaViers, president, South-East Coal Co. and chairman of the National Coal Association's Research and Development Committee, pointed out that the industry, in the light of its financial condition, had done very well to support a research program totaling $17.3 million. He said that the industry will be called upon to produce an added 100 million tons annually if it is to supply 30 per cent of the energy requirements in 1965. He stated that such an expansion program will require developments in mining equipment and in methods and practices at both the production and consuming levels.

LaViers suggested that the committee consider the possibility of new legislation to provide for an agency with adequate industry representation to handle coal research. Such an agency should be coordinating in nature, have power to solicit advisory help from all research branches, and be granted funds which could be used as grants-in-aid or loans and for contracting with outside agencies for the conduct of research programs.

An anthracite spokesman, Frank Earnest, Jr., president, Anthracite Institute, called for a federal appropriation of $2 million annually to finance research on anthracite as a metallurgical fuel, gasification, and new mining techniques.

The hearings recessed until an indefinite date because the heavy agenda of the House required committee members to be on the House floor at the hours usually set aside for committee meetings. Witnesses from the American Mining Congress, Bituminous Coal Research, Inc.; United Mine Workers, and Appalachian Coals, Inc., are scheduled to testify when the hearings resume. It is possible that the hearings may not resume until after Congress adjourns.

Senate Approves Minerals Bill

On June 18, after prolonged debate, the Senate stamped its approval on S. 3982, which provides for the initiation or continuation of government minerals purchase programs for domestically produced tungsten, asbestos, acid-grade fluorspar, and columbium-tantalum.

Under terms of the measure as passed by the Senate the General Services Administration is authorized to carry on the purchase programs over a period ending not later than December 31, 1958. The measure provides for procurement of the following: (a) 1,250,000 short-ton units of tungsten trioxide at not less than $55 per unit f.o.b. mine, except that $63 per unit f.o.b. mine would be paid for production from mines with an annual output not exceeding 1000 units; (b) 2000 tons of crude nonferrous chrysotile asbestos of Grades No. 1 and 2 combined and 2000 tons of Grade No. 3 if offered with either or both higher grades at a ratio not exceeding one to one, at the same prices and specifications as under the recently expired program; (c) 250,000 tons of newly-mined acid grade fluorspar at $53 per short ton f.o.b. mine; and (d) 250,000 lbs of columbium-tantalum at the same price and specifications as under the recently expired program.

The tungsten provision of the bill came under sharp attack on the floor from Senators Dworshak (Rep., Idaho) and Williams (Rep., Del.). Dworshak cited procurement figures of the General Services Administration showing that the government had bought 2.6 million units of domestic tungsten since the beginning of the 1952 fiscal year. He said the GSA report further showed that the three top producers of tungsten mine 45 percent of the total quantity purchased by the government and that the 12 top producers furnish 77 percent of the tungsten purchased by the government. These figures, he said, demonstrated that the bill would not be of much help to the smaller producers. He offered an amendment to restrict the number of units that any one producer could supply the government to 5000 per month, but the Senate rejected this by a 32-22 vote.

The measure was referred to the House Interior Committee which promptly held hearings on June 25 and 27. Felix E. Wormser, Assistant Secretary of Interior, stated that the Senate bill would be difficult to administer and recommended that several amendments be adopted to make the bill acceptable to the Administration. His statement was endorsed by a Bureau of Budget spokesman, which is tantamount to expressing the views of the White House.

Wormser called for amendments which would restrict the amount purchased from any producing tungsten mine to 5000 short ton units per month, set the government price for all tungsten supplied under the purchase program at $55 per short ton unit (thus eliminating the $63 price provided smaller producers under terms of the Senate measure), and eliminate the Senate provisions providing for government purchases of tungsten and fluorspar to be made f.o.b. mine.

Chairman Engle (Dem., Calif.) of the full House Committee made it quite plain that he favored these amendments and would seek their adoption. In the event that the House adopts these changes, the final bill will be written in conference.

No Congressional action is being taken on the other purchase programs which are now in effect because ODM Director Arthur Flemming, in testifying before the Senate Committee, announced that these actions had been taken: (1) GSA has been authorized to extend the mica purchase program for an additional five years, (2) the Interior Department has been directed to study the chrome purchase program and determine what course should be adopted when it expires on June 30, 1957; (3) the beryl program has been extended for another five years, and (4) GSA has been authorized to extend the car lot purchase program for manganese to June 30, 1961, and to establish a procurement program for metallurgical grade fluorspar. ODM made no specific recommendation as to the mercury program beyond saying that it will not expire before December 31, 1957.

Highway Program Approved

Legislation authorizing construction of a 41,000-mile interstate highway net has been approved by the President.

The new law provides that the vast road program be completed during the next 13 years and that ninety percent of the cost be borne by the Federal Government. The bill also provides a three-year Federal aid program for primary, secondary and

(*Continued on page* 82)

AMC Personals

Cecil A. Fitch, Jr., has been made president and general manager of the Chief Consolidated Mining Co., Eureka, Utah, following the resignation of his father. Fitch was appointed assistant general manager of Chief Consolidated in 1945 and was made vice - president and general manager in 1950. **Cecil Fitch, Sr.**, will remain with the mining company in a consulting capacity.

Cecil A. Fitch, Jr.

At the same time Chief Consolidated appointed **W. W. Watson** vice-president. He will also continue as secretary and treasurer.

At the 56th Annual Convention of the Montana School of Mines on June 8, **Horace M. Albright** received an honorary Doctorate of Laws. Mr. Albright also made the Commencement Address.

Hillary W. St. Clair took over June 1 as chief of the Division of Mineral Technology, Region V, for the U. S. Bureau of Mines, with headquarters at College Park, Md. St. Clair has been assistant chief metallurgist of the Bureau since 1954. He first joined the Bureau in 1935.

Charles C. Hilton, personnel director of western operations of United States Smelting Refining & Mining Co., has been named industrial relations manager for western operations at Salt Lake City.

William N. Matheson, Jr., was recently named vice-president of operations for the Oliver Iron Mining Division, U. S. Steel Corp.

Matheson has been actively engaged as an operator and supervisor in charge of Oliver operations for the past 23 years. He was appointed vice-president in charge of sales and planning for Oliver in June 1953.

Douglas D. Donald recently joined the staff of Behre Dolbear & Co., Inc., Mining, Geological and Metallurgical Consultants of New York. He has been employed, for the last five years, by the New Jersey Zinc Co. at Austinville, Va., first on development engineering and, recently, as chief mining engineer of this project. Prior to this, he served as development engineer at an underground limestone operation in Pennsylvania and also carried out geological exploration in Arizona.

E. H. Greenwald, general manager of the Boone County Coal Corp., Sharples, W. Va., for the past four years has joined the firm of Eavenson, Auchmuty and Summers, Consulting Mining Engineers, Koppers Building, Pittsburgh, Pa. Greenwald was first employed as an engineer by the Boone County Coal Corp. in 1942. He successively held the position of chief engineer, assistant to general manager and general manager prior to his resignation.

Horace Y. Bassett has been elected executive vice-president of Calumet & Hecla, Inc. He has been vice-president of operations for the mining, manufacturing and metal fabricating company since 1953.

Rodney E. Sachs, assistant to the president of Boone County Coal Corp., Sharples, W. Va., has been elevated to executive vice-president.

The election of **Andrew F. Denari** as president of the Pittston Co., New York, was announced in late May by **J. P. Routh**, board chairman. The office formerly was held by Routh, who will continue to serve as chief executive officer of the holding company. Denari, formerly executive vice-president, has been associated with Pittston and its predecessors for 30 years.

The appointment of **Michele A. DePietro, Jr.**, as general manager of United States Fuel Co. effective May 7, was announced recently by O. A. Glaeser, vice-president of the Fuel Company. DePietro succeeds **George W. Watkins**, who resigned to become division engineer of the Utah Railway Co.

Before joining U. S. Fuel, DePietro had been general superintendent of the Shannopin Mine of Jones & Laughlin Steel Corp. at Bobtown, Pa., since 1953. Before that time he had been with Island Creek Coal Co. at Holden, W. Va., as division superintendent.

A. V. Sproles, Jr. has been appointed superintendent of the Angle Colliery of Pocahontas Fuel Co. at Switchback, W. Va. Sproles has been employed in the company's engineering department since 1945 following service in the U. S. Air Force. Prior to that time he had been employed in the stores division and the mining department of the company.

Two staff changes in the Chino Mines Division of Kennecott Copper Corp. have been announced. **Howard Wilmeth** has been named mine engineer and **Paul Hunter** has been appointed safety director.

Wilmeth succeeds **W. W. Baltosser** who has accepted an assignment with Bear Creek Mining Co., an exploration subsidiary of Kennecott.

Hunter, who had been safety engineer of the Hurley plant, fills a post that has been vacant for several months. He will coordinate the safety activities of all the division's various plants.

William J. Skewes, chief engineer, Pocahontas Fuel Co., Pocahontas, Va., was honored at the annual Honors Convocation ceremonies at Michigan College of Mining and Technology on June 1. Skewes, who attended Michigan Tech, received the honorary degree of Master of Engineering at the ceremonies.

In presenting Skewes for the degree, Professor Walfrid Been, head of the Mining Engineering Department at Michigan Tech, said, in part: "(He) has brought to the American coal industry, through his service, a rare engineering ability. He typifies the American genius for doing the impossible. He typifies, as well, the American system whereby we combine knowledge, work, and resources to achieve a standard of living and security second to none."

The Chesapeake and Ohio Railway announced three appointments in its coal traffic and development department in Cleveland.

Frank R. Pattison was named assistant general coal traffic agent succeeding **Charles L. Rothgeb**, who retired May 31. **Alton E. Carrick** was appointed coal traffic agent and **Carl B. Weber** was promoted to assistant coal traffic agent.

At the recent annual meeting of Sunshine Mining Co., **Robert M. Hardy, Jr.**, was elected president. He had been executive vice-president and manager of the company's exploration and petroleum divisions before succeding his father as head of the company.

A change in the board of directors resulted from the announcement of the "impending retirement" of **R. D. Leisk**, who has been general manager of the company since 1937 and a vice-president and director in recent years. Leisk declined renomination to the board, but was retained in his positions as vice-president and general manager. His place on the board was filled by **Joel E. Ferris**, Spokane banker.

Peerless Coal Co., at its annual meeting in New York, elected **E. Y. Clausen** as chairman of the board and elevated **Roland C. Luther** from executive vice-president to president of the southern West Virginia coal company. It was also announced that **P. C. Rutschow** has been appointed assistant general manager and **Vance Price** has been appointed superintendent of mines.

The Shattuck Denn Mining Corp. has announced two appointments in its new Development and Research Laboratory at Humboldt, Ariz.

Alba W. Jeffers was named senior research metallurgical engineer. For several years he had been technical representative of American Cyanamid Company's Mineral Dressing Division.

John Q. Jones was named research metallurgical engineer. He had been associated with the Atomic Energy Commission, Raw Materials Development Laboratory at Winchester, Mass. and Grand Junction, Colo., since 1951.

E. F. Kindsvater has been elected president of the Farm Chemical Resources Development Corp.

Two transfers and a promotion in the engineering department of Eastern Gas & Fuel Associates have been announced.

John D. Kalasky, resident engineer at Keystone mine, was transferred back to the Pittsburgh engineering department as ventilation engineer.

B. P. Sheriff, resident engineer at the Helen operation, transferred to Keystone as resident engineer.

John J. Ketz, Jr., transitman at Keystone mine, was promoted to resident engineer and transferred to Helen mine.

Roger O. Oscarson, former secretary of the Northwest Mining Association, has been named to the new position of area minerals officer for the Bureau of Land Management. His territory includes Washington, Oregon and California.

William Pfleeger, Jr., has been appointed as executive assistant by Penn-Dixie Cement Corp. He will serve as assistant to Fred L. Doolittle, newly elected executive vice-president. Pfleeger joined Penn-Dixie in 1945.

H. S. Anderson, former manager of the Arizona Continental Uranium Co., has been named resident engineer of the New York and Honduras Rosario Mining Co., with headquarters in New York. Before joining Arizona Continental, Anderson served as assistant general manager of the New York and Honduras Rosario Mining Company's operations in Honduras.

Edward T. Knight, exploration manager, has been named vice-president of the Rosario Exploration Co., a subsidiary of the New York and Honduras organization. Anderson has also been named a director of the Rosario Exploration Co.

W. A. Haslam was recently elevated to the presidency of Winding Gulf Coals, Inc. He succeeds **J. A. Hunt**, who will continue to serve in a consulting capacity.

W. A. Haslam

Hunt has spent 28 years in the coal industry in the New River and Winding Gulf fields of West Virginia. Haslam has served the company as executive vice-president since last December, when he resigned as vice-president, operations, of the New River Co.

Matthew J. Donachie has resigned as president of the Beryllium Corp. to devote his entire efforts to the directing of research and development. **Walter R. Lowry**, who became vice-president and treasurer last March, succeeds Donachie as Beryllium's president.

Richard M. Quimby, formerly secretary and assistant treasurer, became secretary and treasurer; and **Robert M. Whitaker**, comptroller, was given the additional duties of assistant treasurer and assistant secretary of the company.

Thayer Lindsley, president of Canada's second-ranking nickel producer, Falconbridge Nickel Mines Ltd., has resigned that position and will devote his full time to a new exploration company being formed. His successor as Falconbridge president is **Robert B. Anderson**, formerly United States deputy minister of defense. Falconbridge is a subsidiary of Ventures Ltd., presidency of which Anderson took over several months ago from Lindsley.

Several promotions and appointments have been announced by U. S. Steel Corporation's Coal Division, Gary District, Gary, W. Va.

H. E. Ketter, was promoted from mechanical engineer to district mechanical engineer.

Paul E. Watson transferred from the Lynch, Ky. District, where he was assistant superintendent of the No. 32 mine, to the Gary District as training supervisor for the district.

J. E. Caffrey, was promoted from project engineer to senior mining engineer.

Charles Yurick transferred from the Corbin Washer, U. S. Steel's Coal Division, Lynch, Ky., to the Alpheus Coal Cleaning Plant at Gary as preparation engineer.

William C. Banner was promoted from senior draftsman to mechanical engineer.

Henry L. Pierson has been elected vice-president and secretary of Freeport Sulphur Co. He joined Freeport as assistant secretary in 1939 and was elected secretary in 1947.

North American Coal Corp. has announced the election of **Dr. Robert L. Savage** as vice-president in charge of research. The new position was established to provide for more effective supervision of the company's expanding activities in the processing and utilization of coal and coal products.

— *Obituaries* —

Ralph E. McCormack, 61, manager of zinc metal sales for Eagle-Picher Co., Mining & Smelting Division, and president of Consolidated Supply Co., a subsidiary of Eagle-Picher Co., died May 23.

James Lawrence Head, 61, who retired last year as mining engineer with The Anaconda Co., died June 3 after a long illness.

Prior to his retirement, Mr. Head had been vice-president, since 1951, of the United Engineering Trustees and chairman, since 1950, of the Engineering Societies Library. He served as president of the Mining and Metallurgical Society of America in 1952.

Mr. Head had engaged in mining operations in the West before World War I. From 1919 to 1921 he was with the Braden Copper Co. and from 1921 to 1923 was in charge of the mining engineering office of the Cerro division of the Cerro de Pasco Corp. Before joining Anaconda in 1947, Mr. Head had been with the Chile Exploration Co. From 1942 to 1945, on leave of absence, he served with the Aluminum and Magnesium Division of the War Production Board. In 1951 he took leave to do similar Government work.

NEWS and VIEWS

Eastern and Central states

Coal Reserves Acquired

Pittsburgh Consolidation Coal Co. has acquired 15,000 acres of undeveloped coal reserves in West Virginia from the Lorain Coal & Dock Co., Cleveland, at an undisclosed price. Company officials said the acquisition was made in the "normal course of business" and did not represent any special plans by the company.

Fluorspar Mine Opened

Pennsylvania Salt Manufacturing Co. of Philadelphia has placed its new Dyer's Hill fluorspar mine, Crittenden County, Ky., into operation.

Development of the mine and expansion of Pennsalt's milling facilities in the same area began early in 1954.

With a potential capacity substantially in excess of current requirements, the Dyer's Hill unit supplements other mineral reserves in Western Kentucky acquired by Pennsalt during the past 10 years.

Peabody Approves Merger

Peabody Coal Co. stockholders met in Chicago in May to approve the acquisition of eight Sinclair coal companies and elect a board of directors.

New directors elected are W. N. Deramus, chairman of Kansas City Southern Lines; F. Stillman Elfred, executive vice-president of Olin Mathieson Chemical Corp.; P. M. Francoeur, president of Francoeur & Co., New York export company; L. Russell Kelce, chairman of the company since July 1955; Merl C. Kelce, executive vice-president; and Ted L. Kelce executive vice-president for sales. The board also elected O. Gressens, John Hawkinson and John T. Rettaliata.

The new board elected two administrative committees. The executive committee consists of L. Russell Kelce, chairman, Merl C. Kelce, Ted L. Kelce, O. Gressens and F. Stillman Elfred. The Finance Committee consists of Gressens as chairman, John Hawkinson, Roy O. Park and R. J. Snider. The board also elected James W. Taylor as vice-president, general counsel and secretary, and S. L. Jewell as vice-president and director of public relations. Operating vice-presidents appointed were H. C. McCollum for underground operations, C. P. Arnold for engineering, and Cecil M. Guthrie and D. J. Johnson for strip operations.

New Preparation Plant

New facilities are being installed in the preparation plant of Slab Fork Coal Co., Slab Fork, W. Va., under contract with Kanawha Manufacturing Co. Contract calls for installing a prepared coal dewatering and classifying system, consisting of high-speed shaker screens, coal transporting flumes, conveyors, and a washed-coal crusher.

The facilities, scheduled for completion this month, have a capacity of 100 tph.

New Cement Plant Planned

Medusa Portland Cement Co., Cleveland, will construct a new $12,000,000 cement plant near Wampum, Pa. Engineering plans have already been drawn and all principal machinery is on order.

Productive capacity of the plant will be 2,500,000 bbls annually. It is scheduled for completion before the end of 1957. The project is part of the company's current 4,000,000 bbl capacity expansion program scheduled to be completed within the next 18 months at a cost of $30,000,000.

International Meet

Stockholm, Sweden, will be host to an International Mineral Dressing Congress on September 18-21, 1957, John Hedlund, secretary, has announced. About half of the 25 papers presented will be from Sweden, Norway and Finland. Excursions will be arranged to some of the larger Swedish mines and tentatively to Norwegian and Finnish mines as well.

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Mining Exhibition

THE Southern Appalachian Industrial Exhibit was held in Bluefield, W. Va., May 23-25 with thousands of miners from the surrounding coal fields in attendance. In addition to the large group of manufacturers and suppliers of equipment to the coal mining industry that exhibited their wares, the meeting was highlighted by the annual Pioneer Miners Reunion. J. W. Pero, director of safety and mine inspection for the Pocahontas Fuel Co., was chairman of the Pioneer Miners Reunion Committee. The group is composed of men who have worked for 50 years in and about coal mines without a lost-time accident.

Another event that attracted a great deal of attention was the fossil and mineral specimen contest held as part of the show. Fred Hancock, Bluefield Supply Co., was chairman of this contest committee. It was the first time that such a contest was held but it will undoubtedly become an integral part of the future meetings of the group.

The miner with the longest period of accident-free service in the coal industry in attendance at the Pioneer's reunion was Charles Harris, Pocohontas, Va., retired mine machinist, who worked 62 years without an accident. He won a $100 savings bond for this distinction. Second best safety record at the meeting was that of Charles Davis, Pocohontas, Va., who has worked 61 years with no lost time accidents.

First prize for the fossil contest was taken by Perry Mosely, U. S. Steel Corp. at Gary, W. Va. His prize winning specimen was a lepidodendron, or ancient club moss, or ground pine.

Twelve hundred years of working time in or about our nation's coal mines with no lost time accidents is the proud record of these 22 men. They were honored at the recent Pioneer Miners Reunion held in conjunction with the Southern Appalachian Industrial Exhibit at Bluefield, W. Va., May 23-25

Prize winners at the Pioneer Miners Reunion were, left to right, Mr. and Mrs. C. W. P. Underwood, Davy, W. Va., married for 55 years, who won a $50 merchandise prize for that distinction; Charles Harris, Pocahontas, Va., retired mine machinist, who worked 62 years without an accident and won a $100 savings bond for the top safety record; J. W. Pero, chairman of Pioneer Miners Reunion committee; Charles Davis, Pocahontas, Va., had the second best safety record of 61 years with no lost-time accidents; and J. L. Lewis, Cardinal, Ky., chief electrician for Kentucky Cardinal Coal Corp., who traveled 250 miles to reunion and won prize of $50 in merchandise for that distinction.

Valuable fossils and mineral specimens were on display as part of a new contest. Fred Hancock (left) of Bluefield Supply Co., fossil contest chairman, inspects some of the prize winners with Dr. Bryan Cooper (center) head of Virginia Polytechnical Institute's Department of Geological Sciences, and Dr. Aureal T. Cross, paleobotanist and coal geologist for the West Virginia Geological Survey

The annual gadget contest was won by W. N. Goad, coal inspector for New River and Pocahontas Consolidated Coal Co. Judges chose his oil-flow regulator and control as the best device entered in the competition. The device automatically regulates oil treatment to variations in coal volume over a loading conveyor. It is used in all plants of New River and Pocahontas Consolidated Coal Co.

New Fertilizer Plant

American Cyanamid Co., New York, will build a 200,000 ton per year triple-superphosphate plant at Brewster, Fla., where the company mines phosphate rock. Chemical Construction Corp., a Cyanamid unit, will design and construct the plant in collaboration with Dorr-Oliver, Inc. Construction is expected to be completed about mid-1957.

Anthracite Strike Ends

Glen Alden Corp., Wilkes-Barre, Pa., and the United Mine Workers of America have settled a 15-day strike against the big anthracite producer, the strike arose in protest of the company's withholding of payments to the union's health and welfare fund for the first three months of this year.

Glen Alden had said earlier that it withheld payments in an effort to call attention to what it said was the union's failure to collect delinquent payments due from other unionized anthracite producers. It had charged that failure to collect from other companies had put it at an unfair disadvantage in the anthracite market.

Glen Alden's president, Francis O. Case, said, "We're all happy about the settlement. They collected a lot of money and that's what we wanted. It puts us on a more equitable basis with other companies." Case said later he was hopeful there would be a more stable industry as a result both of the strike settlement and of a new control plan approved by management that will control the tonnage of coal mined each week.

Under the anthracite production control plan, which operates under Pennsylvania law, each cooperating concern accepts a percentage of the production to meet demand.

Rebuild Coke Oven

Koppers Co., Inc. has been awarded a contract by Republic Steel Corp. to rebuild a coke oven battery with auxiliary equipment at the Cleveland, Ohio works.

The 51-oven battery, originally built by Koppers in 1918, will be rebuilt to increase its capacity approximately 25 percent. When completed approximately 1000 net tons of coal will be carbonized per day to produce 700 net tons of furnace coke per day. Auxiliary equipment to be designed and constructed by Koppers will be a flushing system, a coke quenching station and a system of coal mixing bins. There are four batteries of coke ovens at the Cleveland works.

Students Get Report From H. I. Young

Eighty-seven Nyack, N. Y., high school seniors who owned one share of stock in American Zinc, Lead & Smelting Co. received a first-hand report recently from Howard I. Young, company president.

Young had, a day earlier, addressed other share-holders at the company's regular annual meeting in Portland, Me., and the Nyack meeting could be termed a "junior annual meeting."

The seniors jointly purchased one share of American Zinc stock last October to further their study of the Nation's corporations as a part of their American history course. There have been similar instances where classes have purchased stocks, but it is believed that this was the first time that a company president held a private meeting with such holders.

After giving a review of the company's current earnings picture at what he termed the largest stockholders meeting in the company's history, Young answered questions from the floor.

Young is president of the American Mining Congress.

Buys Controlling Interest

Midwest Coal Co., St. Louis, a subsidiary of Peabody Coal Co., has purchased the controlling interest in Midwest-Radiant Corp. and Perry Coal Co. Midwest-Radiant operates a strip mine and Perry an underground mine in St. Clair County, Ill., with an aggregate annual capacity of 1,500,000 tons. O. M. Evans, president of Midwest Coal and vice-president of the other two, was made president of all three.

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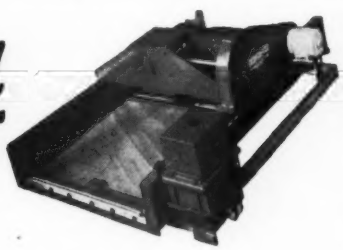

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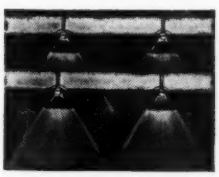

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Coal Industry Moves to Enter Export Shipping Business

An "unprecedented partnership" has been formed to protect the important export coal market "that could go a long way in stabilizing the economy and peace of the world." The American coal industry, the United Mine Workers' union and the principal coal-hauling railroads have joined forces to acquire ships of their own and enter the export coal shipping business.

Walter J. Tuohy, president of the Chesapeake and Ohio Railway, made the announcement at the conclusion of an address on "Coal's Vital Place in World Prosperity and Peace" at a luncheon meeting of the Coal Exporters Association of the U. S., Inc., held in conjunction with the 39th convention of the National Coal Association.

"There is too much at stake," Mr. Tuohy said, "to stand by and do nothing when we see that there are inadequacies in our international coal trade channel. Late last fall the top executives of the industries and organizations most vitally concerned with the overseas export of coal held joint discussions in Washington. Called by Joe Moody, president of the Southern Coal Producers Association, the group included the chief executives of the larger exporting and coal producing companies, the president of the miners' union, and the presidents of the coal-originating railroads.

"A survey of all phases of the export business was made, and on May 28 the group voted to organize a new corporation, to be known as American Coal Shipping, Inc., capitalized at $50 million. Papers of incorporation have been filed. This new corporation will promote the export coal trade on the broadest possible basis. Its first proposal is to enter immediately into the ocean shipping business, by acquiring ships of its own and placing them in the export coal trade. Other plans will follow, directed toward additional problems in the international movement of American coal. It will be remembered that it was four years ago that John L. Lewis proposed a cooperative venture to provide more ships for export coal.

"It is becoming more evident day by day that the foreign demand for American coal is no longer on a spot basis, but permanent and expanding. Contracts three to five years ahead are being signed," Mr. Tuohy said.

Europe cannot supply its own coal needs, he added, mainly because of a declining labor force and the low output per man per day. America, therefore, has to take over the job, he said, and can do it because coal producers are currently making heavy capital expenditures to enlarge operations, increase capacity and reduce costs. This faith and confidence being exhibited by the American coal industry, he said, have spread to our most conservative financial institutions, such as banks, investment houses, and trust funds.

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New Plants in Operation

International Minerals & Chemical Corp., Chicago, has placed into operation new facilities doubling output of dicalcium phosphate at its Bonnie plant near Bartow, Fla. The new facilities were completed six months ahead of the original schedule.

Truax-Traer Gets Little Sister

Truax-Traer Coal Co. recently acquired all of the outstanding capital stock of Little Sister Coal Corp. in exchange for 174,000 shares of Truax-Traer common stock.

The Little Sister properties consisting of over 6000 acres of land, are located near Canton in Fulton County, Illinois, adjacent to Truax-Traer's Fiatt Mine and include strip-mining equipment, a modern preparation plant and substantial coal reserves. The mine has an annual capacity of 800,000 tons.

Truax-Traer has been sales agent for the Little Sister Mine for the past 12 years and has shipped a substantial portion of Little Sister's output over its river loading facilities. The operations of the Little Sister Mine will be integrated with those of the adjoining Fiatt Mine to provide increased capacity and flexibility for the whole operation.

The assets of Little Sister Corporation, including working capital, mining equipment and coal reserves, are valued in excess of five million dollars. Net earnings resulting from the acquisition, based on the additional common shares to be issued, are expected to be substantially in excess of the present per-share earnings of Truax-Traer Coal Co.

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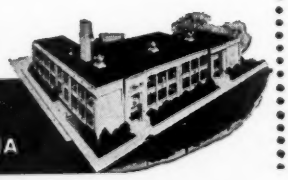

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Waste Treatment Approved

Eleven of 15 coal washing plants in West Virginia's Gauley River basin are operating satisfactory waste treatment facilities, according to the quarterly report of the State Water Commission.

The commisison said that progess in coal washery waste abatement in the Coal River basin, bogged down during the fall and winter months, is now being expedited.

Progress in the Bluestone River and Elkhorn Creek watersheds also is picking up speed, the commission said, and the program in the Guyandotte Basin is getting under way.

Only 10 percent of the 50 coal washeries in the Guyandotte Basin possess adequate waste disposal facilities, the State Water Commission report said.

Sulphur Company Control

More than 50 percent of the voting stock of Gulf Sulphur Corp. has been purchased by E. J. Hudson, president of Hudson Engineering Corp., Houston, Texas, and the New York City investment banking firm of Bear, Stearns & Co. The shares were bought from the Brady brothers of Mexico City and include their minority holdings in the Mexican Gulf Sulphur Co.

Gulf Sulphur concessions cover 7414 acres on the isthmus of Tehuantepec in the State of Veracruz, Mexico. Production is expected soon.

Will Build Coal Barge Unloaders

A contract for the building and erecting of four coal barge unloaders has been awarded to Heyl & Patterson by the New York City Transit Authority.

Two will be located at the 59th Street Power Station on the Hudson River, and two at the Kent Avenue Power Plant in Brooklyn, a dual system assuming positive service at both locations.

Erection is scheduled to begin the early part of 1957, with completion of erection slated for the early part of 1958.

Iron Ore Plant

Blocked Iron Corp. of America, Philadelphia, has initiated construction of the first production unit near Philadelphia of a multi-unit installation equipped to agglomerate "fine" iron ores from foreign sources. The initial unit will cost more than $1,000,000, and completion of the whole project is scheduled for next August.

Both fine and lump ores will reach the Blocked Iron plant within minutes after being unloaded from the holds of ships at the Pennsylvania Railroad's new $12,000,000 ore pier nearby. With the completion next November of a fourth giant unloading machine, the Pennsylvania pier will have a capacity of more than 5000 tons of ore per hour. It is operated by the Pennsylvania Tidewater Dock Co.

Industry Supports Fuel Scholarships

Six scholarships in fuel technology at The Pennsylvania State University have been established by organizations in and serving the coal industry. The announcement was made by Dr. E. F. Osborn, dean, College of Mineral Industries, and Earl C. Payne, consulting engineer of Pittsburgh Consolidation Coal Co., who has been active in recruiting the awards.

The scholarships are available to high school students who can meet the entrance requirements of the College of Mineral Industries at The Pennsylvania State University. They begin with the 1956 Fall term and pay the student $500 per year, with renewal each year contingent on satisfactory academic performance. Penn State is the only school in the nation offering a bachelor of science degree in fuel technology—the application of engineering and chemistry to the utilization of fuels.

Holmes Safety Awards

Medals for heroism have been awarded 11 workers in the nation's mineral industries by the Joseph A. Holmes Safety Association, it has been announced by T. H. Miller, acting director of the Bureau of Mines and association president.

Certificates of honor were awarded four others for skill in using modern life-saving methods in an emergency.

The association also awarded 544 certificates of honor for exceptional safety records and outstanding success in safe supervision. These included certificates for 247 individuals, of whom 61 are officials, 80 coal mines and companies, 87 metal mines and companies, 101 petroleum plants and companies, and 29 quarries and nonmetallic mines and companies.

New Nickel Plant

Freeport Sulphur Co., New Orleans, plans to build an $85,000,000 nickel and cobalt processing plant in one of the Gulf States and to expand its mining operations in Cuba.

Work on the company's pilot plant at Braithwaite, La., is expected to be completed in October. The project was started over seven months ago.

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Wheels of Government

(*Continued from page 74*)

urban road systems, for which the States and the Federal Government share the cost on a 50-50 basis. Total Federal-State expenditures will run to $32.8 billion. For the first three years of the program funds for the interstate net will be apportioned to the various States based on population, area, and rural mail delivery routes. Apportionments for the last ten years will be set by Congress at a later date. The law also requires payment of wages to construction workers at prevailing rates for similar work in the same area as determined by the Secretary of Labor after consultation with State officials.

To pay for the program, the law provides an increase in the existing excise taxes on gasoline, diesel fuel and special motor fuel, from 2 cents to 3 cents per gallon, on tires from 5 to 8 cents per pound, a new tax on camelback of 3 cents per pound and a highway use tax on vehicles over 26,000 lbs. of $1.50 per 1,000 lbs. The tax increases with respect to gasoline, diesel fuel and special motor fuels apply only when used in a highway vehicle which is registered, or required to be registered, for highway use under State laws. The tax increase on tires and tread rubber applies only to the type used on highway vehicles. The law establishes a procedure for refunding the additional one cent gasoline tax where gasoline is used for non-highway purposes.

An increase from 8 percent to 10 percent is provided in the manufacturers' excise tax on trucks, truck trailers, and buses.

Renegotiation Act Revised

The House Ways and Means Committee has approved a bill extending the Contract Renegotiation Act for two years from its scheduled expiration date of December 31, 1956.

Under terms of the measure, a ceiling of $1 million instead of the present $500,000 would be placed on the exemption of defense contracts from renegotiation. The bill redefines a "standard commercial article" as one either customarily maintained in stock or covered by established price quotations.

The Committee made no change in the existing provision of law exempting mineral raw materials from application of the Act.

International Materials Reserve Opposed

Hearings have been held before a Senate Foreign Relations Subcommittee on a bill which would authorize the United States to participate with other members of the United Nations in the establishment and operation of an "International Food and Raw Materials Reserve."

Administration spokesmen opposed the measure. Support for it came from the National Farmers Union, and a number of international organizations and social welfare groups.

Simon Strauss, vice-president, American Smelting and Refining Co., testified for the American Mining Congress in opposition to the bill. He pointed out a number of difficulties that would arise should such a reserve be created and demonstrated that storing of raw materials in foreign nations could have detrimental results upon our national security. He pointed out that when governments operate in the commodity markets the effect is "infinitely more serious than when a private buyer or seller does so." He said governments can make mistakes which can have serious impact upon the economies of the nations involved. He pointed out that efforts in the past to control raw materials through private cartels have ended in failure and that the substitution of "politicians for industrialists will not make the cartel operation more palatable or more effective."

Committee members expressed the opinion that metals and minerals should not be covered by the measure.

Most observers predict that the bill will die in committee.

"Pre-Merger Notification" Hearings

A Senate Judiciary Antitrust subcommittee has held hearings on the "pre-merger notification" bill which passed the House in April.

Representatives Celler and Keating (Reps., N. Y.) and Assistant Attorney General Stanley N. Barnes supported the bill. Keating said that it is contrary to the public interest to allow company mergers which raise antitrust questions to become effective before the Department of Justice or the Federal Trade Commission is able to study them. Barnes offered several amendments to the bill, one of which would exempt from the notice provisions "asset acquisitions if such assets, after deducting that portion thereof comprising stock in trade transferred by this acquisition in the ordinary course of the transferring corporation's business, do not exceed $1 million."

Ellsworth C. Alvord, appearing for the American Mining Congress, said the House bill would "interfere seriously with the discovery and development of natural resources." He cited 12 harmful results which the legislation would accomplish and said that eight of these results could be remedied, or improved to some degree, by technical amendments. The remaining four can only be remedied by a basic suggestion, he declared—"drop the so-called 'pre-merger' notification approach and adopt a system of 'post-acquisition-pre-merger' notification."

With respect to mergers and consolidations, Alvord suggested that corporations be required to furnish notice to the government after the details have been finalized and the plan has been approved by the boards of directors but prior to stockholder approval. However, such notice would have to bear reasonable relationship to the period of time which normally elapses between submission of a plan by the boards of directors to their shareholders and the time of the stockholders' meeting. A 90-day delay is far too long for practical operations, he said, and suggested no more than a 60-day waiting period.

If Congress should decide to adopt a policy of imposing a 90-day waiting period on all corporate mergers and acquisitions, Alvord said that some of the bad effects could be avoided by technical amendments. He submitted 14 amendments, which would help carry out the objectives of the proposed legislation while minimizing its harmful effects.

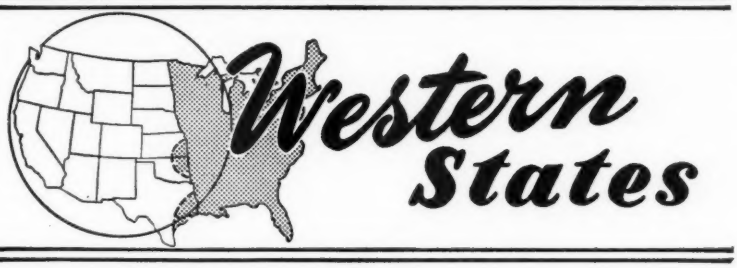
Uranium Program Extended

The Atomic Energy Commission has established a new domestic uranium procurement program for the period from April 1, 1962, through December 31, 1966, and an extension of the initial production bonus for uranium ores from February 28, 1957, to March 31, 1960.

The initial production bonus is paid on the first 10,000 lbs of uranium oxide in ore delivered from an eligible mining property to an authorized buying station or mill. The bonus ranges from $1.50 per contained pound in ore assaying 0.10 percent uranium oxide, to $3.50 per contained pound in ore assaying 0.20 percent or more uranium oxide.

The new program provides a guaranteed market for all uranium concentrates produced by domestic mills from domestic ores, subject to a limitation at AEC's option to 500 tons of U_3O_8 per year for any one mining property or mining operation, and to compliance with AEC specifications. The price will be $8 per lb of U_3O_8 contained in normal mill concentrates or mill precipitates, which is somewhat less than present prices.

Uranium concentrate producers desiring to sell to AEC will be required to enter into contracts specifying the period of delivery, quantity to be delivered, rate of delivery, place of delivery, and type of packaging, and containing other standard clauses of commercial-type contracts. AEC may limit the purchase of concentrates derived from any one mining property or mining operation to 500 tons of U_3O_8 per year. If additional quantities are purchased, such purchases may be at prices lower than $8 per lb.



Montana Coal Plant

Koal Krudes, Inc., Spokane, has awarded a contract for the construction of a coal-processing plant at Red Lodge, Mont., according to Elmo F. Wilcox, president. Construction will start immediately and the company expects to be producing carbonized coal and creosote within about four months. The initial plant building will house up to six retorts and is expected to process 200 tons of coal daily.

Tintic Exploration

Chief Consolidated Mining Co. has announced it expects to reach a "successful conclusion" in negotiations with Bear Creek Mining Co., Kennecott subsidiary, on a multi-million dollar exploration project in the Tintic Mining District, Utah.

Cecil Fitch, Jr., Chief Con president, told stockholders that "negotiations with the Bear Creek Mining Co. covering a unit lease agreement with ourselves and other interests including the East Tintic area of our properties are continuing. Numerous minor details usually encountered in negotiating a lease of this magnitude, are gradually being concluded to the satisfaction of all parties concerned. We anticipate successful conclusion to these negotiations soon. It is our understanding work in this area will commence immediately upon signing of the agreement."

Anaconda Plans Expansion

The Anaconda Co. plans to spend more than $384,000,000 on expansion in the next five years, according to Roy H. Glover, chairman of the board. The investment planned, in plants and properties, he said, "exceed those made during the past ten years; and during this 15-year period these investments will have exceeded the total book value of all the Anaconda properties including its subsidiaries at the end of World War II."

The Berkeley Pit in Butte is scheduled to produce 10,000 tons per day by the end of 1956, and by mid-1957, the production is expected to reach 17,500 tons per day. The company has authorized the Northwest Project for the Butte District, including the Ryan Shaft, which is designed to revitalize the Butte underground operations.

Anaconda also plans to expand its operations in Chile. This includes substantial investments for enlarged production at Chuquicamata, the initiation of work to bring into production the Africana near Santiago, and the initiation of an extensive program for developing the new El Salvador mine near Potrerillos.

Meanwhile American Brass Co. has completed a new plant at Mattoon, Ill., for making flexible metal hose and tubing; has started construction at Terre Haute, Ind., on a new integrated aluminum mill; and at Los Angeles, has started construction on a new brass mill to serve customers in the far West.

To Deepen Shaft

Cayzor Athabaska Mines Ltd., in the Beaverlodge area of Alberta, Canada, will deepen its three-compartment shaft two more levels to 650 ft as a result of encouraging results on the second level, H. T. Leslie, consulting engineer announced recently.

Work will start shortly on the deepening of the shaft and the third and fourth levels will be established at 125-ft intervals, Leslie explained. The first level is at 170 ft and the second at 320 ft. A loading pocket will be located below the fourth level.

Cross-sectional drilling both on the surface and on the lake zone is showing excellent results it is reported.

Silver Dollar Exploration

Deeper exploration of the Good Hope section of the Chester vein in Silver Dollar Mining Co. ground in the Coeur d' Alene district, Idaho is scheduled for this summer, according to Elmer E. Johnston, president. Polaris Mining Co., operator in the area under a working agreement, is planning to prepare drilling stations off the 3000 level, and to run shallow holes through the big vein structure exposed on the 3000 and upper elevations.

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Convention arrangements are in the capable hands of this group which met last month in Los Angeles

Outstanding Program for Los Angeles

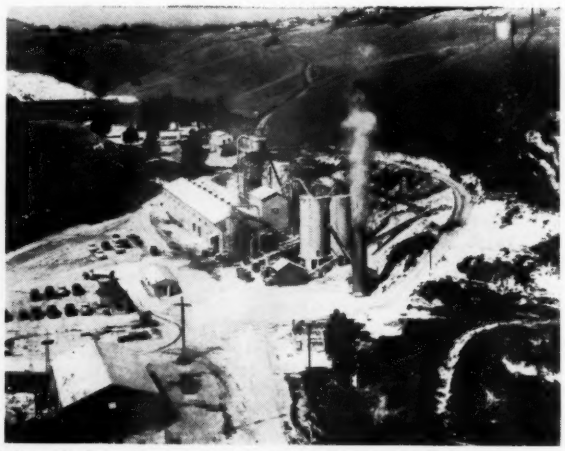
AT A MEETING in Los Angeles on June 19, about 30 State and District Chairmen and local Convention committee members produced an outstanding program for the 1956 Metal Mining and Industrial Minerals Convention and Exposition of the American Mining Congress October 1-4 in Los Angeles Shrine Exposition Hall.

Under the guidance of Walter C. Lawson, National Program Committee Chairman, the group selected, from hundreds of suggestions sent in by scores of interested mining men, program topics which would most likely answer questions uppermost in the minds of men connected with the nation's mining and industrial minerals industries. Among the topics to be thoroughly aired at the October Convention, arrangements for which are under the general direction of Garner A. Beckett, Chairman of AMC's Western Division, are national minerals policies; labor and management; taxation; gold, silver and monetary policies; public lands administration; the outlook for the metal mining industry; industrial minerals; management engineering; underground and open-pit mining; exploration and geology; milling and metallurgy; health and safety; developments in strategic minerals; and mining problems and Federal policies with respect to the uranium industry.

To assure authoritative coverage of these topics, the program committee is inviting top-level Federal Government Administrators, U. S. Senators and Representatives, and experienced operating men to participate in the multifaceted convention program.

Bulwarking the four days of general and technical sessions will be the largest exposition of mining and processing machinery, equipment, and supplies ever held in the West.

So that convention-goers may have ample time to "take in" the exposition, convention sessions will be ar-



Disneyland and the diatomite operations of the Great Lakes Carbon Corp. will be visited by convention-goers

ranged to afford the maximum opportunity for study of the displays and discussion of problems with the experienced manufacturers' representatives who will be in attendance for that purpose.

Full descriptions of the exposition will appear in the September issue of MINING CONGRESS JOURNAL. More than 88,000 sq ft of exhibit space both inside and outside the Shrine Exposition Hall will be utilized in giving mining men a chance to catch up on the latest developments in the "tools" of their trade.

In fact, the comprehensive array of exhibits, coupled with the outstanding convention sessions, constitutes an advanced course in how to mine and process the mineral resources of our country. Mining companies generally recognize this and send every key operating man that can possibly be spared.

The convention - exposition has its lighter side too, with every mining man and lady invited to attend the social functions and other entertainment features arranged for their pleasure. A major event, traditional with these western meetings, is the Miners Jamboree which is scheduled for Tuesday night, October 2, in the Hollywood Palladium. There will be dancing after a fine dinner and lively floor show. Everyone is also invited to attend the annual Speechless Banquet which will be held Thursday, October 4, in the Cocoanut Grove and the Embassy Room of the Ambassador Hotel.

Exclusively for the ladies are two special events—a Welcoming Luncheon at the Biltmore Bowl on Monday, October 1, and a Luncheon and Style Show at the Beverly-Hilton Hotel on Wednesday, October 3.

Other attractions for visitors abound in Los Angeles and the nearby areas. They include Santa Catalina Island and Avalon, famous restaurants and night spots, movieland, shops, golf courses, mountains and beaches. A convention-sponsored trip has been planned through one of the best known attractions, Walt Disney's fantastic Disneyland, for Friday, October 5.

Other special trips scheduled for Friday will afford a fine opportunity to visit mining and industrial operations, including a cement plant, steel mill, mechanized rock products operation, oil refinery, diatomaceous earth production, and a view of Los Angeles Harbor. Complete details on trip and entertainment functions have been mailed to thousands of people in the mining industry. If you haven't already done so, order your tickets promptly to make sure you won't miss these events.

Los Angeles hotels are now being besieged with requests for reservations for the first week in October. If you have overlooked the important matter of assuring yourself accommodations, send your hotel reservation request immediately to the American Mining Congress Housing Bureau, Los Angeles Chamber of Commerce, 1151 South Broadway, Los Angeles 15, Calif.

Montana-Wyoming Uranium

Lisbon Uranium Corp. has announced it has acquired lease on uranium-ore claims in the Pryor Mountain area along the Montana-Wyoming border. Leases are from the Bice Mining Co., which has shipped a few loads of ore from the claims to the Riverton, Wyo., AEC buying station.

Scholarship Given

Consolidated Coppermines Corp. has awarded its third $2000 scholarship to a graduating student of the White Pine County, Nev., High School. It consists of a $500 a year grant for four years. Conditions of the grant are these, the student must be in the top half of the graduating class, must have engaged in extra curricular activities, must have shown definite leadership ability, and must be in need of financial help.

Big Expansion at Ray

Kennecott Copper Corp. has started a $40,000,000 program at its Ray Mines Division in Arizona involving the building of a smelter at Hayden and extending its open-pit mine at Ray. The program is expected by 1958, to result in a 20,000 ton increase in the division's annual copper production. In 1955, Ray Mines Division produced about 50,000 tons of copper.

Present mining limits of the pit will be extended so that adjacent and deeper sections of the ore body may be mined. The program involves relocation of a creek along one edge of the pit and relocating many surface installations which were built years ago to serve former underground mining operations. Additional mining and milling equipment will be required for the production increase.

Construction of the smelter will permit Kennecott's Ray Mines Division to handle its own output which heretofore has been done on a toll contract basis by a custom smelter.

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Anaconda Announces Top Management Changes

C. E. Weed

T. A. Campbell

W. K. Daly

Chas. Brinckerhoff

R. E. Dwyer

E. O. Sowerwine

ELECTION of three officers of The Anaconda Co. was announced recently by Roy H. Glover, chairman of the board of directors. Clyde E. Weed, vice-president in charge of operations since 1952, was elected president of the parent company and three subsidiaries, Chile Copper Co., Chile Exploration Co. and Andes Copper Mining Co., effective July 1. Thomas A. Campbell, executive vice-president of Chile Exploration Co. and Andes Copper Mining Co. since 1952, was elected vice-president of the parent company; and W. Kenneth Daly named vice-president and comptroller of Anaconda, effective June 1. Daly has been comptroller of Anaconda since 1940. Campbell has also been elected president of Anaconda Sales Co., selling organization for The Anaconda Co. and its mining subsidiaries. It was also announced that Charles Brinckerhoff, who has been general manager in charge of South American operations of Chile Exploration Co. and Andes Copper Mining Co. since 1948, had been elected vice-president of both companies. He will continue as general manager of South American operations, with his home and office at Chuquicamata, Chile. Robert E. Dwyer, president of Anaconda, who started with the company at Anaconda, Mont., in 1903, retired July 1. Elbert O. Sowerwine, a vice-president since 1945, retired on June 1. He joined the company at Anaconda, Mont., in 1907.

Mining Booms in Philippines

Mineral production in the Philippines reached a record peak in 1955. Continuing a steady rise since the end of the war, the combined output of metallic and non-metallic minerals was up 14 percent over the previous year for a value of 167,781,916 pesos. (The Philippine peso, officially valued at $0.50, is currently quoted on the free market at around $0.37).

The director of the Philippine Bureau of Mines, in his annual report, notes that mining in the country during 1955, was dominated by three major developments: rapid expansion of the nation's copper production, definite steps toward exploitation of the rich nickel resources of the islands, and heightened activity in the exploration for petroleum.

Gold is still the leader in total value of annual production. In 1955 the country produced 419,112 ounces of gold valued at 43,860,071 pesos. But the significant fact is that, while this was slighty more in quantity, it was less in value than the previous year's output, which amounted to 416,052 ounces valued at 44,808,800 pesos.

The abundant iron ore resources of the Philippines last year just about held their own as a source of national income. Production increased slightly—1,432,712 metric tons as against 1,424,898 metric tons in 1954—but somewhat lowered prices dropped the value to 24,039,909 pesos, as compared to 24,878,184 pesos in 1954.

But while gold and iron were relatively static, other minerals forged ahead.

The limelight in the Philippine mining picture during 1955 was occupied by copper. The country's total copper output showed a notable increase in quantity and value—17,461 metric tons of metal valued at 29,795,296 pesos, as compared with 14,349 metric tons sold for 18,973,080 pesos in 1954.

Another metal rich in immediate promise for the Philippines is nickel. Exploration has established large deposits of nickel in the Government's Surigao mineral reservations, which extends over some 87,000 acres in northeastern Mindanao and adjacent islands.

Chromite also looms large in the expanding Philippine mining industry. In 1955 the country's production of refractory chromite rose to 535,262 metric tons valued at 16,145,280 pesos, as against 388,590 metric tons worth 11,565,290 pesos in 1954.

A completely new addition to the nation's mineral output was introduced last year when Palawan Quicksilver, in its first five months of operation, turned out 635 flasks of mercury valued at 354,470 pesos.

Happy Jack Uranium

The Texas Co. has reached agreement with owners of the Happy Jack Uranium Mine in White Canyon, San Juan County, Utah, that their purchase option will be picked up as soon as a favorable form of ruling is obtained on tax situation from the Internal Revenue Service.

UCN To Build Uranium Mill

The U. S. Atomic Energy Commission and the Union Carbide Nuclear Co., a division of Union Carbide and Carbon Corp. have signed a contract providing for the construction and operation by UCN of a new uranium processing mill at Rifle, Colo., and for two new ore receiving stations and chemical upgrading plants on the Colorado Plateau. One of the upgrading stations will be near Slick Rock, in San Miguel County, Colorado, and the other at Green River, Emery County, Utah.

The new Rifle uranium mill will be situated about two miles down the Colorado River from the present UCN mill, and will be of larger capacity than the present plant. A lack of space and the tailings disposal problem led to the decision to build an entirely new mill at Rifle instead of expanding the old one.

The two new ore receiving and upgrading stations at Slick Rock and Green River will consist of facilities for receiving, crushing, sampling, and beneficiation of crude ore by means of processes developed by Union Carbide Nuclear Co. The product then will be sent to the Rifle mill for processing to an acceptable uranium concentrate for sale to the Commission under the terms of the contract.

Construction of the new mill and ore receiving stations is expected to start right away. To supply the new facilities, Union Carbide will purchase a certain amount of amenable ore from independent producers in the respective regions.

Potash-Borax Merger

The directors of the Pacific Coast Borax Co. and United States Potash Co. have agreed on a merger of the two companies. The name of the new company will be United States Borax & Chemical Corp., Horace M. Albright, United State Borax president and James M. Gerstley, Pacific Coast president have announced. Pacific Coast Borax is the American affiliate of Borax, Ltd., London.

New Smelter For Kennecott

Western Knapp Engineering Co. of San Francisco has been awarded the contract to construct a new smelter for the Ray Mines Division of Kennecott Copper Corp. in Hayden, Ariz.

Amount of the contract was not disclosed, although the company previously had announced it intended to spend approximately $40,000,000 for a new smelter and for expanding the company's mill at Hayden and open pit mine at Ray.

The smelter, which will be able to treat approximately 25,000 tons of copper concentrate per month, is to be completed in 20 months. The division's smelting currently is handled by a custom smelter at Hayden. The new smelter, which will increase production appreciably as a result of the mine and mill expansion, is to be located nearby.

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— BOOK REVIEWS —

THE Virginia Polytechnic Institute has just issued a bulletin (March 1956) by David Townsend Stemple on "A Study of Problems Encountered in Multiple-Seam Coal Mining in the Eastern United States." The subject is especially timely as the coal industry, facing an increased market will of necessity be forced to expand its operations in older fields and to work seams that are either above or below the earlier mining. Also, this need for increased territory will bring about greater attention to conservation and higher recovery rates.

The booklet presents in condensed form (61 pages) a fairly complete review of present and past mining, citing examples of how the extraction of one seam has affected the difficulties of mining seams above and below it. Sufficient data is given in the maps and drawings to show what effect can be expected in the underlying and overlying beds, with different physical conditions, such as intervals between the seams, depth of cover, thickness of coal and character of the strata. The effect of complete and partial recovery is also described.

Charts cite numerous examples of conditions and results in working overlying and underlying beds as well as simultaneous mining of contiguous seams. As can be expected, where such a variation of factors exist, no set conclusion can be drawn, although the writer does state (correctly we believe) that where possible, the upper seam should be mined first.

The booklet concludes with this excellent statement, "Regardless of the method of mining chosen for the recovery of continguous beds, the importance of careful planning cannot be emphasized too greatly. . . . It most certainly will reduce the difficulties of multiple-seam mining, thereby producing more economically a maximum recovery of one of the nation's most valuable mineral commodities, coal."

INDUSTRIAL HYGIENE TRANSACTIONS BULLETIN NO. 29, *Industrial Hygiene Foundation of America, Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa., $5.00.*

PAPERS and addresses given at the 20th Annual Meeting of the Industrial Hygiene Foundation of America last November have been made available in this transaction.

MODERN TECHNIQUES OF EXCAVATION. *Herbert L. Nichols, Jr., North Castle Books, 212 Bedford Rd., Greenwich, Conn. $9.00.*

THIS is an abridgement of MOVING THE EARTH, The Workbook of Excavation, that sells for $15.00. The book includes all 11 chapters of Part I of the larger work, to which has been added some to-the-point criticism of present-day equipment. An additional chapter, "Hints on Maintenance," is also included. The Appendix and Glossary of the larger volume is retained and there is a complete new index. The abridgement does not include the ten chapters in Part II of the larger book, which describes the construction and operation of the equipment, as it has been prepared primarily for contractor and engineer personnel who are not directly concerned with purchase for operation equipment.

Profusely illustrated, MODERN TECHNIQUES OF EXCAVATION provides complete information about the planning and execution of dirt and rock excavation in grading projects of all kinds. Two chapters deal with financial management, estimating, insurance, and certain aspects of equipment maintenance.

A valuable addition to the book shelf of any mining engineer, it is a "must" for those who are engaged in strip or open pit mining and surface construction work.

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Care of Bearings

(Continued from page 64)

roller assemblies are made by means of the collars on the shaft which are locked in position by set screws. Other adjusting devices may be used, however, the recommended setting for conveyor bearings is 0.002 in. to 0.005 in. end play or free running bearings. The bearing adjustment must not be confused with possible drag from the seals.

Pillow Blocks

Pillow blocks are used on a variety of mining equipment such as conveyor drives, screens, pulverizing equipment and many other applications. Shim adjusted bearings are used on both expansion or floating boxes and non-expansion or fixed boxes. Usually the bearings are set with free running clearance or about 0.002 in. to 0.005 in. end play or slightly more for the larger boxes. Here again, the setting will depend on the application to some extent and if there is any question, the equipment builder or the bearing company should be consulted.

Lubrication

Mine Car Wheel Bearings

Bearings, wheel hubs and hub caps should be packed with grease until it appears outside of dust collar. A list of greases which have been tested and approved by The Timken Roller Bearing Company will be furnished upon request.

New Cars

New cars are usually shipped fully lubricated, yet in order to avoid the possibility of trouble due to lack of grease in the wheel hub, the wheels of all new cars should be inspected carefully. The most certain way to do this is to force grease into the hub until it appears around the dust collar.

Water

No anti-friction bearing will function properly for a long period of time if water is permitted to come in contact with the rolling surfaces. Where it is necessary to operate cars in a mine where the tracks are submerged, new grease should be forced into the hub frequently with a grease gun to remove the water which may have entered.

Mine Locomotive Bearings

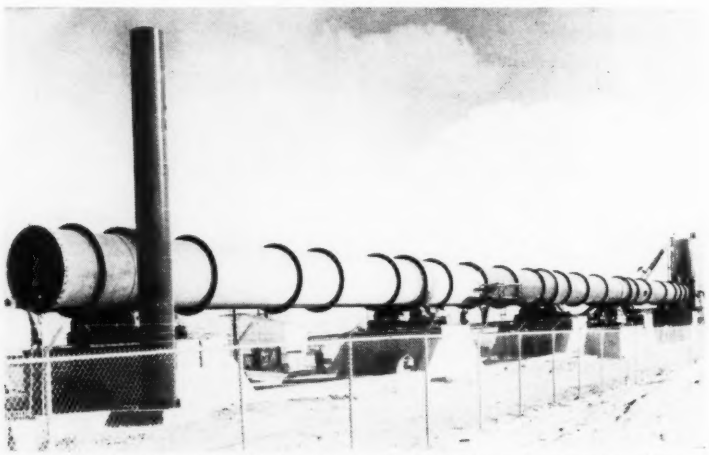
A pressure grease gun should be used for the lubrication of the journal box bearings. The boxes should be filled with grease until the grease begins to leak out at the closure. Bearings should be lubricated daily unless it is found from close observation of operating conditions and from a periodic check of the bearings that such frequent lubrication is unnecessary. Grease should be added until clear grease appears at the closure, and a grease from the approved list of lubricants for mine cars should be selected.

New Locomotives

New locomotives or spare units equipped with bearings are shipped fully lubricated, yet in order to avoid the possibility of trouble due to lack of grease all bearing boxes should be inspected carefully. Again, the most certain way to do this is to force grease into the boxes until it appears around the closure.

For all other applications, follow the recommendation of the equipment builder. The types of oils and greases will vary, both in types and amounts to be used, with the various designs and applications, so it is not practical to make general recommendations.

New Lime Plant In California



This 340-ft rotary kiln highlights the new lime burning and processing plant of West End Chemical Co., Westend, Calif. On stream in mid-1956, this plant will produce extremely high purity, high calcium quicklime and hydrate. Source of material is a limerock mountain, 4 miles long, ¾ mile wide, 800 ft high, discovered in 1955 by West End in the Argus Range bordering historic Panamint Valley in the California desert. The limerock will be processed in crushers and classifiers at the quarry site and at the West End plant site in the 340-foot rotary kiln and hydrators of latest design. Large new storage and shipping facilities have been constructed to support expanded sales of West End hydrate and quicklime both within and beyond California

New Mexico Uranium Mill

American Metal Co., Ltd., and Sabre and Pinon uranium companies have submitted a proposal for a multi-million-dollar uranium mill to the Grand Junction operations office of the Atomic Energy Commission. The mill would be constructed in the Grants, N. M. area.

Deepen Lucky Friday Shaft

Deepening of the new three-compartment shaft at the Lucky Friday Silver-Lead Mines Co., east of Mullan, Idaho, an additional 700 ft to the 3000 level, has been authorized by company directors. Preparations for the shaft-sinking program are now under way. Waste pockets are being cut and stoping areas are being prepared on the 2150 and 2300 levels so that waste from the shaft work can be used for stope-filling and need not be hoisted to the surface.

Colorado Coal Map Available

A map showing the geology and distribution of coal resources in the Gulnare, Cuchara Pass, and Stonewall area, Huerfano and Las Animas Counties, Colo., has been released by the U. S. Geological Survey.

Coal deposits of this area, which is part of the Trinidad coal field, are estimated to exceed 2¼ billion tons. The coal occurs in beds of late Cretaceous and early Tertiary age and is high volatile A and B bituminous coking coal.

Titled "Geology and Coal Resources of the Gulnare, Cuchara Pass, and Stonewall area, Huerfano and Las Animas Counties, Colorado," the publication is issued as Map C 26 of the Coal Investigations series. Copies may be purchased at 75 cents per set from the Distribution Section, Geological Survey, Denver Federal Center, Denver, Colo., and from the Chief of Distribution, Geological Survey, Washington 25, D. C.

Manufacturers Forum

Dragline Bucket

AMONG THE FEATURES of this new bucket line pointed out by the Bucyrus-Erie Co. are: High arch of bucket which provides wide opening and clearance for loading and dumping; "slicing action" lip; solid or two part Becoloy teeth, hardened for maximum wear; tapered basket reportedly scientifically shaped to load full and fast and to dump quick and clean; and a free-rolling dump block equipped with sealed tapered roller bearings.

The buckets, offered with either solid or perforated baskets, are made of Becoloy, a steel alloy developed by company metallurgists for dragline bucket service.

For further information write Bucyrus-Erie Co., South Milwaukee, Wis.

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THE THIN PLIABLE WALLS of the low pressure Terra-Tires enables them to absorb or conform with uneven surfaces without resisting them and to glide over soft "giving" surfaces without bogging down.

According to the Aviation Products

Div., The Goodyear Tire & Research Co., future evaluation flights are expected to confirm the belief that airplanes equipped with these tires can operate in and out of plowed fields, clearings and other rough ground not cluttered with major obstacles, ice and snow-covered areas, as well as marshy and sandy regions.

Gravity Anomaly Simulator

AN INSTRUMENT that simulates the effect on the earth's gravity field of a subsurface body of anomalous density has been announced. This instrument will be of value in interpreting data obtained when prospecting for petroleum and minerals with gravity meters. It is claimed the new Gravity Anomaly Simulator makes it possible to prepare gravity data in hours that would require days by previous calculating methods. The instrument measures 24 by 19 by 31 in. and weighs 24½ lb.

For complete details, write to Houston Technical Laboratories, 2424 Branard St., Houston 6, Texas, asking for Bulletin No. GM 203.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Office Automation

A METHOD of housing and indexing strips of perforated paper tape and edge-punched cards to save time in common-language data-processing operations, has been announced by Remington Rand, a division of Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y. The method is an adaptation of Kardex, the visible-record system.

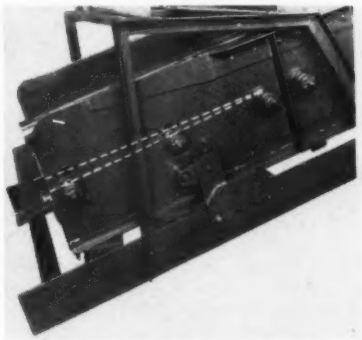
Hydraulic Pump

GASOLINE OPERATED, this lightweight hydraulic pump with a displacement of 30 cu in. of oil per minute is said to raise a 60-ton capacity ram one inch in half a minute. Known as the No. 798 GM, the pump unit provides continuous operating pressure of 5000 psi and intermittent pressure up to 10,000 psi. When used with Simplex "Re-Mo-Trol" rams, the No. 798 GM provides combinations with capacities from 10 to 600 tons.

Detailed application data on the entire line of Templeton, Kenly Hydraulic pumps, rams and jacks can be secured by writing for new bulletin: "Hydraulic 56." Address: Templeton, Kenly & Co., 2525 Gardner Road, Broadview, Ill.

Adjustable Panel Screens

TYPE UHS VIBRATING SCREENS have undergone some design changes according to the Deister Machine Co. The changes involved making screen



cloth panels at both the feed and discharge ends independently adjustable in order to increase or decrease the screening angle. For complete details and specifications of the new adjustable panel screens, write the Deister Machine Co., 1933 East Wayne St., Fort Wayne 4, Ind.

Air Saw

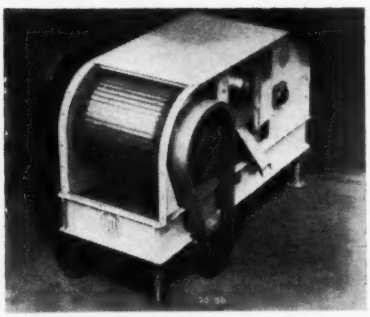
WEIGHING ONLY 14½ lbs, complete with sawblades, the Wright Air Saw has twin, interlocked, reciprocating sawblades. It uses less than 60 cfm of air at 90 psi but operates at

70 to 100 lb. Manufactured by the Wright Saw Division, Thomas Industries Inc., Louisville 2, Ky., the saw operates off a 60 cu ft air compressor —two units off a 105 cu ft compressor.

Drum-Type Dryer

FOR BATCH OR CONTINUOUS DRYING of feeds ranging from pasty or doughy mixes to distinctly granular material, the Drumulator consists of a stainless steel heated drum with flanged outer edges that carries a continuous stainless steel belt. Material is dried in the space between the heated surfaces of the drum and belt.

Among advantages cited by the



manufacturer are: requires no heavy foundation and a minimum of floor space; completely enclosed and easy to clean; usually eliminates need for crushing after drying; handles material that heretofore could be dried only on tray dryers.

Details on this recently announced drum-type dryer may be obtained from The Jeffrey Manufacturing Co., Columbus 16, Ohio.

Drum Separator

DESIGNED FOR RECOVERY OF MEDIA in heavy density plants, the WPD wet drum magnetic separator is described in Bulletin 87 by Stearns Magnetic, Inc., Milwaukee, Wis. The magnet provides correct flux distribution for positive transport of the collected magnetics to the discharge point. Alnico permanent magnets are used requiring no external energization—eliminating cost of rectifier or motor generator set.

Vibration Monitor

OIL-TIGHT AND DUST-TIGHT, a malfunction detector has been introduced that anticipates trouble and shuts down rotating equipment before costly damage occurs, according to the Beta Corp., Forest Ave. at Ridge Rd., Richmond 26, Va.

Applications include ventilating fans, blowers, air compressors, MG sets and other rotating equipment.

The vibration responsive switch can be obtained in an explosion proof enclosure for hazardous locations.

Diesel-Powered Lift Trucks

LOWER FUEL CONSUMPTION and longer engine life are reported advantages of diesel-powered lift trucks manufactured by Hyster Co.

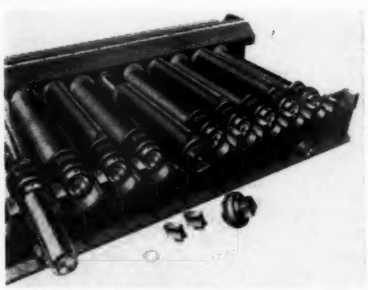
Available for lift trucks of 6000 and 8000 lb capacity is the Perkins P4 (4 cylinder) diesel unit. Hyster 15,000, 16,000, 18,000 and 20,000-lb capacity lift trucks can be factory equipped with the Perkins P6 (6 cylinder) model.

Waukesha model 180 DLC four cylinder engines are offered installed on Hyster's solid - cushioned - tire 3000, 4000 and 5000-lb capacity lift trucks.

Descriptive literature and specifications may be obtained by writing to Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore.

Feeder-Scalper

FOR HEAVY-DUTY USE in mining, quarrying and the cement industries, this feeder-scalper is manufactured by the Universal Engineering Corp., 625 "C" Ave., N. W., Cedar Rapids, Iowa.



Called the "Wobbler" feeder, the machine performs feeding and scalping functions in one operation. A capacity of up to 2500 tph is claimed, depending on driven speed, Wobbler bar spacing and character of material handled, and size of scalped product can be controlled down to ¾-in. minus.

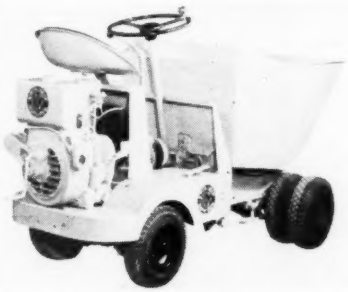
Tube Fitting

SPECIFICALLY DESIGNED FOR HIGH-PRESSURE SYSTEMS, the type 7000 Series Ermeto S. A. E. Flareless, Straight-Thread Hydraulic Tube Fitting is produced by the Weatherhead Co., Fort Wayne Div., Fort Wayne, Ind. Designed to accommodate minimum close coupling, positive seal and ease of assembly, the Ermeto tube fitting is stocked in 31 different styles and in sizes from ⅛ to 2 in.

Material Handling Unit

AUTOMATIC POWER FLOW TRANSMISSION as standard equipment on Model R-15 Moto-Bug is said to provide an increase in speed, power, operating ease and production capacity. Speed on this material handling unit has been increased to 12 mph. The power ratio of 4 to 1 reportedly multiplies engine torque range as much as 200 percent.

The Moto-Bug features the provi-

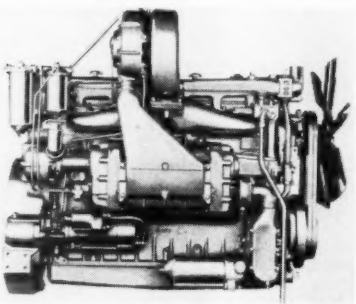


sion of three interchangeable body attachments on a single standard chassis for loading, lifting or hauling various material with one basic unit. Additional features include an 80-in. turning radius, 32-in. width, 18 to 1 steering gear reduction, variable speed belt driven power transmission from a standard 8.3 hp gasoline engine and reliable two-wheel drive with internal expanding type brakes on both wheels.

More complete descriptive literature and specifications on the Moto-Bug may be obtained by writing to the Kwick-Mix Co., Port Washington, Wis.

Two-Cycle Diesels

THREE TURBOPOWER ENGINES have been added to the Series 71 line of industrial two-cycle Diesels, according to the Detroit Diesel Engine Div. of General Motors. Presently



available are four- and six-cylinder fan-to-flywheel engines and a six-cylinder base-mounted power take-off unit.

The four-cylinder engine has a rating of 171 basic hp at 2300 rpm, and the "six" is rated at 236 basic hp at 2100 rpm. Both units are suited for use as replacement power in on-and off-the-highway trucks.

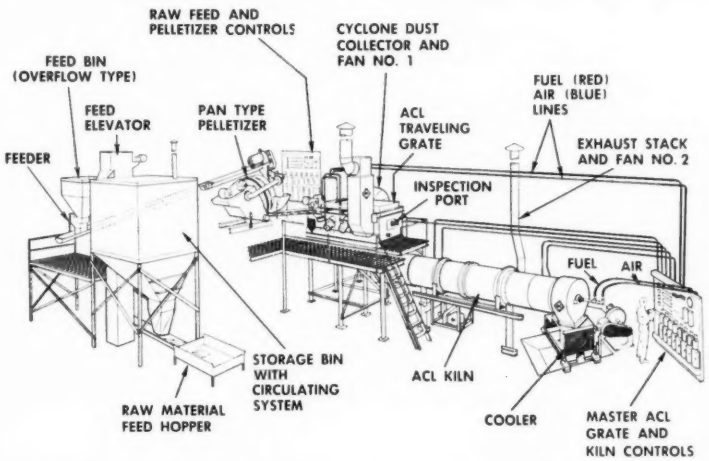
Wisconsin Pilot Plant

ALLIS-CHALMERS has announced the opening of a new pilot plant for the purpose of testing, demonstrating, and developing untried raw materials and new techniques in cement making with the ACL traveling grate process. The pilot plant is located at the company's Heat Processing Laboratory, Carrollville, Wis.

Essentially the ACL system consists of three parts—a pelletizing operation, a traveling grate for drying and partially burning the pellets, and a short kiln for final burning. Conventional wet and dry cement manufacturing processes use only long kilns.

The ACL system takes up only a little more than half the space of conventional units. It reportedly features uniform pellets from raw material to finished clinker, and the lowest fuel consumption and dust loss of any rotary kiln cement process known.

The ACL pilot plant plus the company's research facilities now enable Allis-Chalmers engineers to duplicate every stage of manufacturing cement, from grinding of raw materials to fine grinding of finished cement.



Time Switch

A GENERAL-PURPOSE time switch has been announced by General Electric's Instrument Dept. Suitable for indoor and outdoor use, the heavy duty TSA-40 will turn electric circuits on or off at any time of day. It is furnished with either a plain dial for fixed time setting or an astronomic dial for dusk and dawn schedules. Its four-watt motor with permanent silicone-grease lubricant sealed in has positive operation from minus 50°F to plus 150°F, making the timer adaptable for almost any climatic conditions. Operating voltage is 120, 240 and 480 volts ac. Frequency is 60, 50, and 25 cycles.

Seismograph Camera

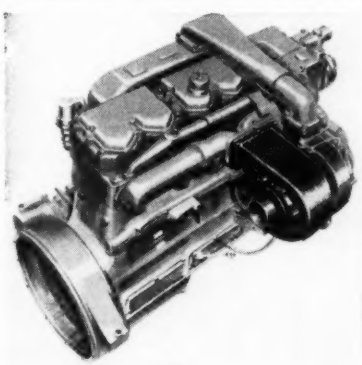
A SEISMIC RECORDING OSCILLOGRAPH—designed to operate with all seismic recording techniques—is a product of Houston Technical Laboratories. For high, conventional, or low frequency seismic recording, or use with magnetic recorder, the RS-8U camera is said to have complete operational latitude. The entire camera is compact, measuring 30 in. high by 12.8 in. wide, and has an over-all weight of 61 lb.

For Bulletin S-313 containing further information on the RS-8U Recording Oscillograph, write to Houston Technical Laboratories, 2424 Branard St., Houston 6, Texas.

Turbodiesel Engine

THE 335-HP Cummins NRTO-6 turbodiesel engine is a six cylinder, four-cycle engine with a bore and stroke of 5⅛ by 6 in. and a piston displacement of 743 cu in. Compression ratio is 14.5 to 1.

Use of a new exhaust gas turbocharger, designated T-590, plus the Cummins PT Fuel System is said to give the engine ideal torque characteristics.



The NRTO-6 is manufactured by Cummins Engine Co., Inc., Columbus, Ind.

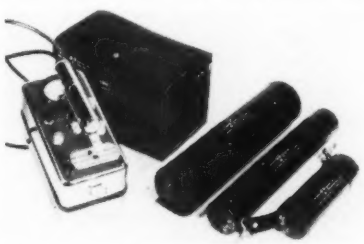
Tandem-Axle Trucks

THE NEW LINE of tandem-axle 6-wheel Dodge trucks ranges from 31,000 to 46,000 lb maximum gross vehicle weight and up to 65,000 lb maximum gross combination weight. They are powered by V-8 engines ranging up to 220 hp and 5-speed transmissions are standard equipment.

Known as the KX, TX, and YX models, the trucks are reportedly designed for maximum flexibility and traction in rough off-highway operations.

Geiger Counter

THIS RADIOACTIVITY DETECTOR, called the Multi-Lokator, features the use of the "Geiger Multiplier" tube. The Geiger Multiplier tube can be desribed as a bundle, or sheaf of Geiger tube elements in a common housing, of which the cathodes are in the form of grid-like screens. This offers several chances for each gamma ray to produce an



ionizing event. Thus, a greater percentage of the incident radiation results in the click-producing "electron-avalanche", according to the manufacturer. In addition, it is said the Multiplier tubes provide from 10 to 50 times more actual gamma-sensitive volume than conventional Geiger tubes.

For additional data on the three models of Multi-Lokator, characterized by successively larger Multiplier tubes, write to The Radiac Co., 489 Fifth Ave., New York 17, N. Y.

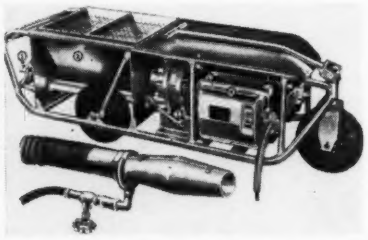
Concrete Vibrator

NEW MOTOR-IN-HEAD concrete vibrator is lightweight, easily handled by one man, and capable of operating from any 110 v. current, according to Maginniss Power Tool Co., Mansfield, Ohio. Its universal ac-dc motor is reputed to provide high frequency, low amplitude vibrations up to 10,000 vpm in medium or high slump concrete.

For further information on the Model UCV-9 Maginniss Uni-lectric vibrator, write Maginniss Power Tool Co., 154 Distl Ave., Mansfield, Ohio, for folder LL-2670.

Rock Duster

FOR WET OR DRY DUSTING, this high pressure portable type rock duster delivers from 35 to 60 lb of dust per minute through 50 to 400 ft of 1¾-in. hose. Equipped with wet



nozzle and water supply at 20 to 25 lb pressure, on shift dusting may be kept within the 40 ft of the face area prescribed by the Bureau of Mines, according to the manufacturer.

Additional data on the Little Chief Duster may be obtained from The American Mine Door Co., Canton 6, Ohio.

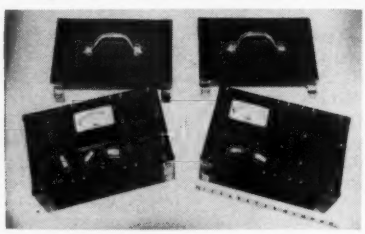
Slinger Belt

THE CARLOADER BELT consists of special construction to combat high speeds, small pulleys and chemical reaction of materials handled. Available in three sizes, this belt is made endless by vulcanizing at the company's plant.

Additional information may be obtained from the Thermoid Co., Trenton, N. J.

Prospecting Instrument

THE RESISTIVITY SYSTEM is useful in the location of sulfide ores, water, geologic faults, and other anomalies characterized by abrupt changes in electrical resistance. It



weighs less than 25 lb, is only 14¼ in. wide, and is designed for use with the Wenner Electrode Configuration. The Resistivity System is also readily adaptable for use with the Lee Configuration.

For Bulletin E-401, write to Houston Technical Laboratories, 2424 Branard St., Houston 6, Texas.

Hydraulic Governor

THE class 3300 Farris-Pickering Governor reportedly features full work capacity with complete regulation over the full range of speed settings for constant speed governors. Its rated work is 123 in.-lb, and rated torque is 159 lb-in. Steady state stability is said to be better than 0.1 percent. Isochronous or speed-droop characteristics are obtainable by manual adjustment.

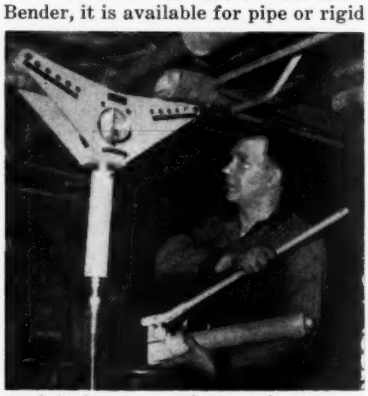
Complete technical and performance data on the hydraulic governor is available from: Farris Pickering Governor Co., Inc., 587 Commercial Ave., Palisades Park, N. J.

Slurry Tests

IT IS NOW POSSIBLE to determine in advance friction losses and critical carrying velocities of particular slurries because of the development of a slurry test laboratory by Morris Machine Works, Baldwinsville, N. Y. By knowing these factors in advance, it is easier to select the most efficient pump and pipe sizes to handle a particular slurry.

Pipe Bender

WHEN BENDING PIPE with the 68-lb RC remote control bender it is possible to make any degree bend in one setting. According to The Tal Co., 417 N. Water St., Milwaukee 2, Wis. Called the RC 200 Tal One Shot Bender, it is available for pipe or rigid



conduit, bus bar and for radiant heat. It can also be had to bend EMT or copper tubing, and with a pipe straightener, if used with the standard all purpose frame. The bender may be obtained with an electric motor pump.

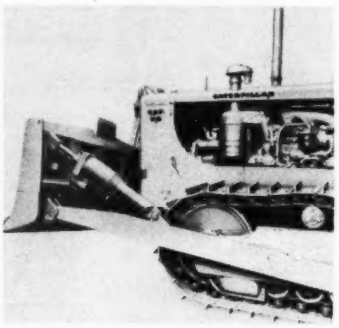
Bulldozer

THREE ANGLING BLADE BULLDOZERS, designed for use with Caterpillar No. 977, No. 955 and No. 933 Traxcavators have been announced by Caterpillar Tractor Co., Peoria, Ill. The new bulldozers have been designated the No. 977A, No. 955A and No. 933A respectively.

With the exception of the No. 933A C-frame group, these bulldozers consist of the same blade and C-frame groups as the No. 6A, No. 4A and No. 2A Bulldozers. Strong links are used to connect the bulldozer C-frame to the Traxcavator lift arms. The same hydraulic controls and cylinders are used for both bucket and blade.

Bulldozer Tilting Attachment

A HYDRAULICALLY ACTUATED bulldozer tilting attachment for use with No. 9S and 8S Bulldozers has been announced by Caterpillar Tractor Co., Peoria, Ill. Heart of the new attachment is a large hydraulic cylinder which replaces the left bulldozer blade brace. The left cylinder is controlled from the operator's seat by



means of a front-mounted No. 44 Hydraulic Control or the new rear-mounted No. 48 Hydraulic Control.

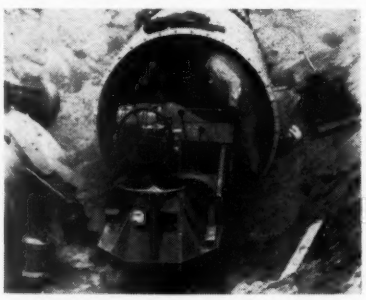
According to the company, the attachment is designed to give the D8 and D9 Tractors increased versatility on jobs which require frequent tilting of the blade.

Flattened Strand Wire Rope

AN EXTRA HIGH STRENGTH GRADE of flattened strand wire rope has been announced by Leschen Wire Rope Div., H. K. Porter Co., Inc., 342 Madison Ave., New York 17, N. Y. Round strand ropes has been available in the new grade for some time. This stronger grade will be called Porter Imperial Red-Strand Wire Rope, and all ropes of this quality will be fabricated with steel cores.

Ore Carriers

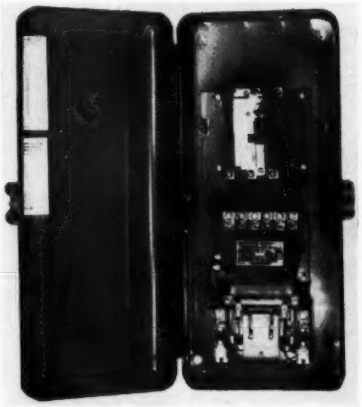
DIESEL POWERED for in-mine use the Scoot-Crete ore carriers operate without rails, ties, or external power sources. The largest Scoot-Crete is Model CD-3, which has a load-carrying capacity of 10,000 lb and a 144-in. turning radius. Smaller



models have a load capacity of 14, 16, 20 and 27 cu ft. They are built and marketed by Getman Brothers, South Haven, Mich.

Circuit Breaker

A NEW, SMALLER "E" FRAME circuit breaker has been developed by the General Electric Company's General Purpose Control Dept. This

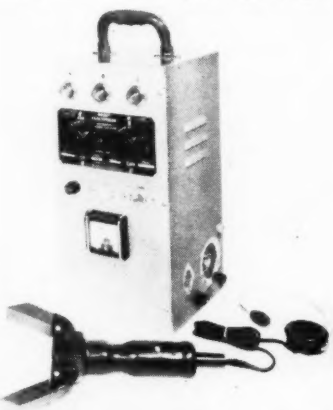


breaker is now standard on all the department's combination starters with breakers rated 250 v, 100 amp maximum, according to the manufacturer.

Circuit breaker has an interrupting capacity of 7500 amp and will be supplied on General Electric CR 7008 combination starters, CR 7010 combination reversing starters, and CR 7108 combination multi-speed starters in sizes 0-3.

Faultfinder

A COMBINATION GROUND DETECTOR and fault locator for use on normally ungrounded power circuits while these circuits are energized, the Model No. 58 Brunt Faultfinder weighs 27 lb and has the dimensions 15 by 8 by 7 in. The manufacturer states that it was especially designed



for use in plants having several distribution centers of widely separated voltages and can be used on voltages from 120 to 600. Its strength is reportedly such as to permit the use of the instrument on circuits buried in the earth or in concrete, or on overhead circuits, without the necessity of placing the exploring coil on the conduits or cables.

Address inquiries to C. M. Parr, Jr., Parr Manufacturing Corp., 48 Hale St., Crawford, N. J.

Jaw Crusher

BELIEVED TO BE THE LARGEST overhead eccentric jaw crusher in current market production, the Universal 4448 "WRB" is manufactured by the Universal Engineering Corp., 625 "C" Ave., N. W., Cedar Rapids, Iowa.

The crusher possesses these design features: Stress-relieved, welded-steel base; extra long jaws, stationary: 102 in., movable: 115¼ in.; spherical self-aligning bearings hydraulically removed; rocker-type steel toggle plate, steel-plated shims and hydraulic cylinders.

Approximate capacities range from 200-350 tph at a four-in. discharge opening to 800-950 tph at the maximum 12-in. opening.

— ANNOUNCEMENTS —

John Graham, general manager of sales for the **American Steel & Wire Div.**, U. S. Steel Corp., retired June 1, after 45 years of service in the sales department of the division. Graham has long been associated with the American Mining Congress and at the time of his retirement was a member of the board of governors of the Manufacturers Division.

Shelly G. Hughes has been elected president of **Differential Steel Car Co.**, succeeding **H. Fort Flowers**, now chairman of the board. **H. H. Houck** was elected senior vice-president, and **D. F. Flowers**, vice-president, Sales, Metal Mines Department.

Joy Mfg. Co. has announced the appointment of **P. M. Sheriger** as sales manager, Metal and Non-Metallic Mining, with headquarters at the company's executive offices in Pittsburgh, Pa. Prior to this appointment, Sheriger was field sales manager with Joy.

Lewis C. Black has been appointed sales manager—large machines for **Bucyrus-Erie Co.**, effective July 1. He succeeds **R. M. Dickey**, who resigned April 15.

Appointment of **Jack G. Errion** to the position of assistant to the domestic sales manager was announced by **LeTourneau-Westinghouse Co.** Errion, who has been serving as sales promotion manager for the firm, will direct the company's sales training program as well as assist in domestic sales activities.

American Mine Door Co. has announced the appointment of **William B. Vance, Jr.** as representative in the Southern Appalachian coal fields. The company has had no representation in this area since the death of Samuel Hager last January.

Robert H. Weeks, Jr. has been appointed New York district manager for the **Edison Storage Battery Division of Thomas A. Edison, Inc.** For the past 19 years he has been district manager for the company in San Francisco.

Kennametal, Inc. has announced the appointment of **Edward J. Carroll** as assistant sales manager of the Mining Tool Division. Carroll joined Kennametal from the Coal Division of U. S. Steel Corp. For eight years he was employed at Robena Mine and was assistant superintendent for the last three years. Before that he spent five years in the Mining Engineering Department.

Rod Eagan, advertising manager, **Goodman Mfg. Co.**, has retired after 40 years of service. He has enjoyed a varied and active career with Goodman in both the replacement part and advertising phases of the business and was particularly well versed in the many changes that mechanization has brought to the coal industry. Replacing him as advertising manager for Goodman is **Clarence Graham** who is rounding out his nineteenth year of association with the company.

Robert E. Spoerl has been appointed chief sales engineer for the conveyor and elevator belting department of **United States Rubber Co.**

Easton Car & Construction Co. has announced the appointment of **George Sines** as chief engineer of the company's Industrial Car Division.

The Electric Storage Battery Co., Philadelphia, has appointed **William E. Fischelis, Jr.**, manager of advertising and sales promotion of its Exide Industrial Division.

W. F. Blanchard has been elected vice-president and general manager of **Yuba Manufacturing Co.** He was previously secretary and treasurer. Blanchard will have direct responsibility for Yuba's entire operations at its plant on upper San Francisco Bay.

SEE NEXT PAGE FOR CATALOGS —BULLETINS

CATALOGS & BULLETINS

AMERICAN PERMISSIBLES FOR THE COAL INDUSTRY. *Explosives Dept., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.* This reference bulletin, listing permissibles available for all shooting conditions, has been compiled on the proper use of permissibles for coal mining and other underground mining where fumes or unusual dust problems occur. Storage procedures as well as preparation and blasting practices are outlined.

TROLLEY MATERIAL. *The Elreco Corp., Cincinnati 25, Ohio.* A complete line of trolley material for mines is listed in Elreco's Catalog ME-100.

LIMBEROLLER BELT IDLER. *Joy Mfg. Co., 307 Oliver Bldg., Pittsburgh 22, Pa.* Booklet 2-3 contains design and application data for those who select, specify, purchase and use belt conveyors to handle bulk materials. Included are descriptions, dimensional drawings, specification tables and suggested applications for Limberoller idlers and various troughing, impact, training and return brackets to use with belt widths of 18 through 72 in.

R-15 REAR-DUMP. *Euclid Div., General Motors Corp., Cleveland 17, Ohio.* Catalog illustrates the major design and operating features of the R-15 Rear-Dump Euclid and provides performance data and general specifications. Rated payload of the unit is 15 tons with standard 14.00 by 24 tires.

MOTOR GENERATOR SETS. *Allis-Chalmers Mfg. Co., 972 S. 70th St., Milwaukee, Wis.* Bulletin 05B8175 describes the Allis-Chalmers line of large pedestal-bearing synchronous motor-generator sets for rolling mills, mine hoists, paper machine drives, etc. Units covered are available in standard 2-machine sets—200 to 3500 kw output—125,250 or 600 volts d-c; standard 3-machine sets—300 to 7000 kw output—125, 250 or 600 volts d-c; and in special combinations to meet special requirements.

ROLLER CHAIN AND SPROCKETS. *Link-Belt Co., Dept PR, Prudential Plaza, Chicago 1, Ill.* Information on the company's line of roller chain and sprockets is contained in Link-Belt Book 2457. Included are sections on stock drives, drive chain, conveyor chain, installation and maintenance, lubrication, sprocket wheels, casings, and chain

SYMONS CONE CRUSHERS. *Nordberg Manufacturing Co., Milwaukee 1, Wis.* The operation and design features of Standard and Short Head Type Symons Cone Crushers are described in complete detail in the 24-page Bulletin No. 247. Diagrams show the flexibility of arrangement of the crusher for both stationary and portable plant service.

TEXROPE DRIVES. *Allis-Chalmers Mfg. Co., 972 S. 70th St., Milwaukee, Wis.* Bulletin 20P50 is a 44-page booklet that provides selection tables for A, B, C and D section variable speed drives. In addition it includes information on design features, drive principles, horsepower rating tables for A, B, C, D, and E section belts, a speed range table showing the variation in rpm when using two "Vari-Pitch" sheaves in combination, and accessory equipment for the "Vari-Pitch" drive.

THOR AIR TOOLS. *Thor Power Tool Co., Aurora, Ill.* The No. 44 Catalog, second edition, lists the company's complete line of mining and contractors' tools. A typical page shows a photograph of a basic Thor tool, complete descriptive matter on the tool and its related models, and a specification table together with information on repair kits. Full listing occurs on attachments, accessories and replacement parts available with all tools.

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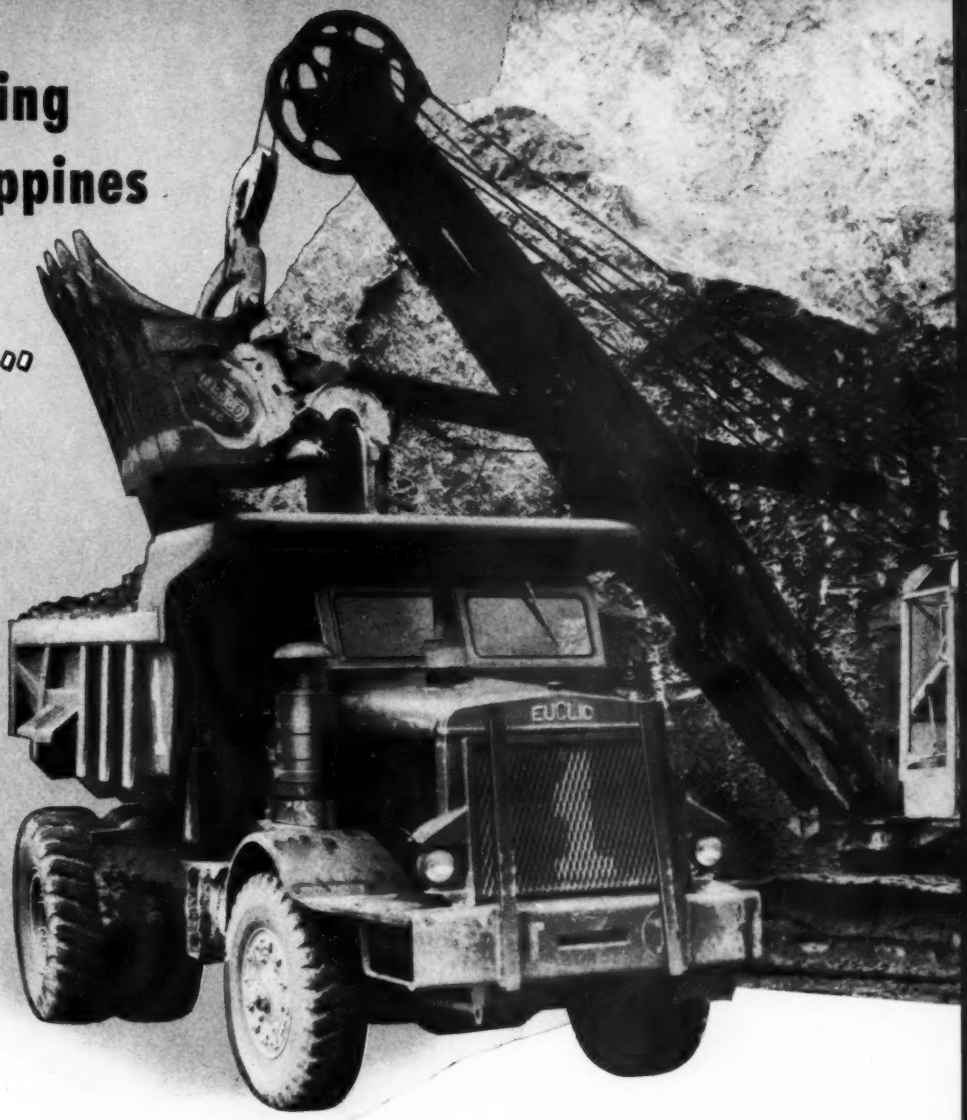
Copper Mining in the Philippines with "Eucs"



Two Rear-Dump Euclids of 22-ton capacity deliver 6000 tons of ore per day to the crusher . . . six others haul overburden to waste areas.

The new Toledo Mine of Atlas Consolidated Mining & Development Corp. on the island of Cebu is the largest open pit copper mine in the Orient. First ore was delivered to the crusher in early 1955 and operations are now being expanded to more than double the original milling capacity.

Atlas selected 22-ton Rear-Dump Euclids to handle the bulk of the overburden and ore hauling. Two of them supply the mill with about 6,000 tons of ore per day, hauling an average of 1600 feet from the loading shovel. Six of the "Eucs" move overburden out of the pit to waste dumps from 1500 ft. to 1½ miles away.

With 300 h.p. diesel engines and Torqmatic Drives, these big Rear-Dumps have plenty of power to move capacity loads over steep grades and tough haul roads. They've kept hauling costs below original estimates and have proved their workability so well that the company is adding eight more 22-ton "Eucs" to the original fleet.

Dependable performance and simple, rugged construction are mighty important considerations when choosing haulage equipment for remote locations like this mine in the Philippines. Excessive down time would seriously curtail production—or even result in a complete shutdown of operations. Have your Euclid dealer show you performance data on mine and quarry work similar to yours and you'll find that ***Euclids are your best investment.***

EUCLID DIVISION, GENERAL MOTORS CORPORATION, Cleveland 17, O.

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Laminated construction means the M-S-A COMFO CAP protection is built-in, layer by layer. Quality materials, blended to provide maximum strength without excessive weight, are used. This method means exact positioning of the reinforcing pieces for maximum safeguard. But that's only part of the protection story. To make sure these material layers are *permanently welded*, more than 2000 pounds of pressure, and carefully controlled heat, are used in our molding process. The result is a one-piece, smooth, laminated shell that gives miners an extra margin of safety. Streamlined design makes it ideal for low roof conditions. Resists mine water, oil, sweat.

inside

... quality design and material selection for

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M-S-A Comfo Cap suspensions are designed to provide maximum protection, better distribution of impact. Crown straps are of high quality material selected for strength, comfort and durability. The entire suspension assemblies are tailored for top comfort. Available in either Standard Sized Laced type or Adjustable Laced type suspensions covering full range of head sizes—6½-7¾.

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Small wonder M-S-A Comfo Caps are turning head accidents into incidents in mines everywhere. Tough, rugged *laminated* shell construction dissipates the force of impact —engineered suspensions cushion the blow, permit non-slipping adjustment that means accurate fit. And comfort qualities encourage full-time hat use. Our bulletin gives complete details. Write for your copy.

COLORS! M-S-A Comfo Caps available in red, white, green, yellow, blue, brown, gray, and black.

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